NATIONAL SCIENCE FOUNDATION

ADVANCED TECHNOLOGY SOLAR TELESCOPE

RECORD OF DECISION

I. INTRODUCTION

The mission of the National Science Foundation (NSF), an independent federal agency created by Congress in 1950, is focused on promoting the progress of science. To carry out its mission, NSF is authorized and directed, "to initiate and support basic scientific research and programs to strengthen scientific research potential and science education programs at all levels in the mathematical, physical, medical, biological, social, and other sciences . . ." The construction of an Advanced Technology Solar Telescope (ATST) is consistent with this mission and was articulated in the National Academy of Sciences/National Research Council report entitled "Ground-Based Solar Research: An Assessment and Strategy for the Future", 1998, and in the NSF and National Aeronautics and Space Administration (NASA) "Astronomy & Astrophysics Survey Committee Decadal Survey", 2000. The ATST would be the world's flagship facility for the study of magnetic phenomena in the solar atmosphere and would be the first large, ground-based, open-access solar telescope constructed in the United States in more than 40 years.

Understanding the role of magnetic fields in the outer regions of the Sun is crucial to understanding the solar dynamo, solar variability, and solar activity, including flares and mass ejections, which can significantly affect life on Earth. Among the specific research subjects that the ATST is designed to address are: processes whereby cosmic magnetic fields are generated and how they are destroyed; the role played by cosmic magnetic fields in the organization of plasma structures and the impulsive releases of energy seen ubiquitously in the universe; mechanisms responsible for solar variability and its impact on climate; and the conditions responsible for solar activity, including solar flares and coronal mass ejections, which can impact terrestrial communications and power systems. In addition, the telescope would contribute to improved understanding of space weather, which creates hazards for communications to and from satellites, and affects the safety of astronauts and air travelers. No comparable facility currently exists, nor are any competitive facilities being planned. The critical observations that ATST would enable cannot be obtained by any space-based facility currently in operation or being planned. NSF has supported the nine-year, $24.6 million ATST design and development program headquartered at the National Solar Observatory (NSO). A proposal to fund the construction of the 4-meter, adaptively-corrected telescope was received in FY 2004 and has been extensively reviewed as the design matured and critical technology was developed.

A. BACKGROUND OF THE ATST PROJECT

ATST construction has been endorsed by three reports of the National Academy of Sciences:

1. *Ground-Based Solar Research: An Assessment and Strategy for the Future* (the "Parker Report," National Academies Press 1998).

2. *Astronomy and Astrophysics in the New Millennium* (the Astronomy and Astrophysics Decadal Survey, National Academies Press 2001).

3. *The Sun to the Earth and Beyond* (the Solar and Space Physics Decadal Survey, National Academies Press 2003).

Solar and space physics and solar astronomy are growth fields. A number of universities are building solar research groups. No similar project existing or planned worldwide has the scientific scope encompassed by the ATST. The construction and operation of ATST would attract new researchers to these fields and guarantee the Nation's continued primacy in these areas of study.

B. THE ATST AND THE SUN-EARTH CONNECTION

In 1908, George Ellery Hale discovered that magnetic fields permeate sunspots, and that discovery started a revolution that turned solar science into a field encompassing, and often advancing, many branches of physics. In particular, much of our solar research now involves magnetohydrodynamics (MHD), the study of plasmas (electrically conductive gases) whose shapes and flows are influenced by magnetic fields.

Solar energy is the primary driver of terrestrial climate. Although we are relatively certain that the Sun's average energy output will remain nearly constant for several billion more years, the Sun is not a placid object. The complex interactions of the solar magnetic field, the origin of which we do not understand, with the convective energy transport in the other regions of the Sun give rise to a host of phenomena broadly grouped under the heading of 'solar activity.' These include pores, sunspots, prominences, solar flares and coronal mass ejections. In addition, magnetism clearly plays an important role in the heating of the outer layers of solar atmosphere – the chromosphere and corona – and in the driving of the solar wind, the supersonic flux of particles from the Sun that interacts with the Earth's magnetosphere.

The basic physics responsible for even the crudest aspects of solar activity is not well understood. Why, for example, does the number of sunspots and active regions vary periodically along with flips of the global solar field? What mechanisms are responsible for the origin and generation of solar magnetic fields? What is the physical mechanism that is responsible for the energy release in a solar flare or a coronal mass ejection? Our answers to these and related questions are incomplete, but all are intimately connected to the physics of solar magnetism. We do know that changes in the solar magnetic field produce solar flares, coronal mass ejections, and cause variations in the solar wind. All of these processes have profound impacts on human society, driving terrestrial climate, determining the state of the Earth's atmosphere and magnetosphere, affecting communication, power transmission and other activities on the Earth's surface, and presenting hazards to humans in commercial air space and beyond.

Sunspots are the best-known manifestations of large magnetic systems found in the outer third, or so, of the Sun. The source of the Sun's energy, hydrogen fusion, occurs only in the core. The remainder of the Sun is a massive blanket serving two functions. First, it compresses the core to keep fusion going; and second, it moderates the flow of energy from the core into space. The outer region of the blanket is the convective zone where giant gas cells circulate like water in a

boiling pot, bringing heat to the surface. At the same time, solar rotation moves the cells around the Sun, somewhat like massive weather systems. Because the gas is electrically conductive, this motion produces a series of massive dynamos generating magnetic fields that stretch and shear, disconnect and reconnect. The magnetic fields inside sunspots span a volume several times larger than Earth, which means that sunspots are produced by immensely powerful dynamos.

Magnetic activities below the photosphere are hidden from view because the gas is optically dense: atomic particles are so tightly packed that photons — from gamma rays down to radio waves — are absorbed almost as soon as they are emitted. If not for this, the Sun would rapidly cool. When the gas density drops, light can travel freely and it forms what we see as the visible "surface" of the Sun, the photosphere. Here, twisted magnetic fields loop out of the convective zone, into space and back to form an array of features, including sunspots, plages, filaments, and prominences. Magnetic fields reach through the overlying chromosphere and into the solar corona where they can become unstable and trigger coronal mass ejections, or simply open into interplanetary space. When massive fields pierce the visible surface, they form the darkened, cooler areas — sunspots — where the magnetic field keeps hot gas from rising from the interior.

These phenomena affect life on Earth. The 11-year sunspot cycle (actually one half of a 22-year "Hale" cycle) is one of the better-known characteristics. But the various forces that drive the cycle, and determine its intensity and its relationship with conditions around and on Earth remain poorly understood. Historical evidence indicates that changes in the sunspot cycle impact Earth's climate, although modulated by terrestrial events such as volcanoes.

Interestingly, we are currently in a deep solar minimum:

- Sunspot counts for 2008 and 2009 are at their lowest since 1913.
- The solar wind pressure is at a 50-year low.
- The solar irradiance is at a 12-year low.
- Solar radio emissions are at a 55-year low.

What does this bode for climate? As noted above, the historical record shows, perhaps circumstantially, that prolonged periods of inactivity correspond to cool terrestrial climates. Are we entering another "Maunder Minimum" period of terrestrial cooling? The question cannot yet be answered but the next solar cycle will certainly be an important one.

Solar physicists employ a flotilla of space-based instruments along with assets on the ground to monitor the Sun. None, however, has the required resolution to study the genesis of solar activity at a resolution corresponding to the fundamental length scales for field formation – about 20-30 kilometers. Only the ATST would provide the capability to do so and to provide the data required to unravel the generation, interaction, and destruction of the magnetic fields that are at the root of solar activity.

Space Weather: The Sun's atmosphere is highly variable as it responds to a changing magnetic field. The resulting dynamic physical conditions often lead to explosive dissipation of magnetic energy over a wide range of scales and intensities. "Space Weather" refers to conditions on the Sun and in the solar wind, magnetosphere, ionosphere, and thermosphere that can influence the

performance and reliability of space-borne and ground-based technological systems and can endanger human life and health. Through mechanisms that are not well understood, magnetic fields generated in the convective outer layers of the Sun transfer energy to and heat the outermost layers of the solar atmosphere. These processes of solar activity can lead to extremely energetic events in these layers, namely, solar flares and coronal mass ejections (CMEs), the latter being the most spectacular manifestations of solar activity. A large CME can carry up to 10 trillion kilograms of matter away from the Sun at speeds up to 1000 kilometers per second. When the Earth is in the path of this material, such as it was for the very large events of October-November 2003, the geomagnetic storms that result pose hazards to the space and ground assets of both military and civilian communities, including electric power grids and communications systems.

A few examples suffice to demonstrate the vulnerability of our technology-dependent society to typical space weather events[1]:

1. In 1989, a solar storm tripped a protective switch at the Canadian Hydro-Québec power company. For nine hours, the entire province of Québec was without power. At the time, officials said that the problem nearly spread to the United States through an interconnected grid.

2. In a 1997 solar storm, an AT&T Telestar 401 satellite used to broadcast television shows from networks to local affiliates was blacked out.

3. A more serious breakdown of communications occurred in May 1998, when a space storm disabled PanAmSat's Galaxy IV. Among the Galaxy IV casualties: automated teller machines; gas station credit card handling services; 80 percent of all pagers in the United States; news wire service feeds; CNN's airport network; and some airline weather tracking services.

Although the impact of these events was serious, the magnitude of the solar activity that gave rise to them is small compared to the so-called Carrington Event of 1859. This series of solar storms and attendant coronal mass ejections was so severe that it caused disruption of the telegraph system, a low-tech system by today's standards. The great geomagnetic storm of May 1921 was a similar event. While rare, the occurrence of at least two such severe space weather events in the past 150 years suggests that others are likely to occur in the future. A recent National Research Council Study, "Severe Space Weather Events – Understanding Societal and Economic Impacts Workshop Report"[2] considered both the direct and collateral effects of severe space weather, the vulnerability of our technical infrastructure, and estimated the cost of recovery from a severe geomagnetic storm scenario as $1 trillion to $2 trillion during the first year alone for the societal and economic costs of a severe geomagnetic storm with a recovery time of four to ten years. While the ATST will not mitigate against such impacts, discoveries it would make with respect to the root mechanisms responsible for solar activity may improve our

[1] http://www.astrobio.net/news/modules.php?op=modload&name=News&file=article&sid=720)
[2] http://www.nap.edu/catalog/12507.html

ability to predict when solar flares and attendant CMEs will occur, which would allow us to better prepare for and address the consequences of these situations.

Plasma Physics and Astrophysics: The physics of magnetically confined plasmas at work in the solar atmosphere bears directly on other problems in astrophysics such as jets in active galaxies and quasars and cataclysmic variable stars. Furthermore the dynamics of solar magnetic flux tubes are similar to the experimentally produced arched and twisted flux tubes that are generated by advanced pulse power techniques. Both are governed by the same magnetohydrodynamic equations and modeled by similar numerical simulations. In a very real sense, the Sun provides an important plasma physics laboratory to study behavior on large scales while laboratory experiments allow similar effects to be studied under well-controlled conditions.

Education and Public Outreach (EPO): The Sun is an ideal object for teaching physical and mathematical concepts at all levels because of its proximity to Earth, the wide range of observable phenomena it exhibits, and the impact of these phenomena on the Earth. The scientific and technical challenges of the ATST provide many opportunities for training the next generation of solar physicists and instrumentalists and for education and public outreach (EPO). The ATST project, the close collaboration among the national laboratories and the universities involved in its development, and the exciting science it will enable, provide the opportunity to educate and bring students and postdoctoral candidates into solar research. Several students have already participated in instrument design, the site survey, and theoretical work aimed at quantifying ATST requirements.

The ATST EPO program will leverage existing NSO programs within the partnering groups and create new opportunities for student and public involvement, including:

- Hands-on activities for schools and at partners' public displays and visitor centers.
- Web-based solar observatories that can be used by students and the public at large, tailored to various grades and ages.
- Educational modules based on solar observing for teachers.
- Solar research classroom activities.
- Research Experiences for Undergraduates and Research Experiences for Teachers participants will be included in ATST development and outreach programs and in ATST research projects.
- Internship and workforce development programs on Maui, including a new partnership with Maui Community College (MCC) (funded at $2 million per fiscal year for a period of ten years, beginning in FY 2011) responsive to the Native Hawaiian community's interest in cultivating and reinforcing the intersection between Native Hawaiian traditional cultural practices and science, and targeted at increasing the participation in Science, Technology, Engineering, and Math (STEM) careers by Native Hawaiians and Pacific Islanders.

C. THE SCIENCE DRIVERS DICTATE THE DESIGN OF THE ATST

Over the last two decades a remarkable change has taken place in solar physics. The increasing power of numerical simulations of MHD has transformed the field from a phenomenological

science, describing the appearance of the wide variety of magnetic phenomena, to a quantitative one that investigates their nature and connections between them. Computer models have predicted that important interactions occur in the solar atmosphere on very small scales and evolve quickly. Unfortunately, the spatial and temporal resolution of solar observations and their spectral coverage have not been sufficient to verify the predictions of the numerical models. As a result, the simulations cannot be confronted with real observations with comparable detail and temporal sampling and many fundamental questions regarding solar activity remain unanswered.

Taken together, the three requirements of spatial resolution, temporal resolution, and spectral coverage lead naturally to a telescope with a 4-meter diameter and all-reflective optics. Management of the solar thermal flux and mitigation of refraction drives the design to an off-axis, Gregorian optical system. Operational considerations including the need for rapid instrument changes, queue observing, and simultaneous observations with several instruments result in a telescope with instrumentation always at the ready to be used individually or in combination.

D. THE SOLAR RESEARCH COMMUNITY'S IDENTIFICATION OF POTENTIAL SITES FOR THE ATST

Prior to presenting the proposal to construct the ATST to the NSF, the solar research community conducted a thorough investigation into potential sites that would meet the scientific objectives of the proposed project. At the outset of that investigation, it was not known whether multiple candidate sites, one site, or no sites would meet the science requirements.

In the late twentieth century, a group of universities and laboratories formed a consortium to develop clear scientific objectives that would address the needs for fundamental measurements of solar magnetic variability and then to submit a proposal to the NSF to develop a concept that would address these needs. These objectives are defined and discussed in the Final Environmental Impact Statement (FEIS), Section 1.4.2-Purpose of the Project. In 2000/2001, these groups formed a Science Working Group (SWG) to quantify these science goals and translate them into design specifications for the telescope and site characteristics that would permit the telescope to obtain data that could meet the science objectives. A conceptual design for the telescope was developed that could fulfill the design specifications and, hence, meet the science goals if properly sited. Through this process, the science drivers were translated or "flowed down" into well-defined demands on both the telescope design and the detailed characteristics required of any potential site.

In 2001, a smaller group, the Site Survey Working Group (SSWG), was formed to evaluate potential sites based on whether they would meet the scientific objectives and, thus, the purpose and need of the proposed ATST Project. The conceptual design for the proposed ATST Project was the basis for a construction proposal submitted to the NSF in January 2004. The construction proposal has gone through extensive review based on this design, which assumed the existence of a site that could meet required observational conditions.

The charge to the SSWG was as follows (FEIS at Vol. II, Appendix O-ATST SSWG Final Report, Chapter 2, p. 10):

The main objective of the ATST site survey is to ensure that the ATST is located at the best feasible site. The task of the SSWG is to advise the ATST Project Scientist on how to perform the ATST site test campaign. The goal of the site survey is to ensure that the ATST is located at a site that allows the ATST to meet its science requirements. The SSWG is composed of solar physics community members with a range of expertise that includes site testing and solar observing. The SSWG reports to the Project Scientist on a regular basis.

The SSWG will:

- *Develop, review and evolve a site-testing plan*
- *Specify site requirements based on science requirements stated in the ATST proposal*
- *Consult with the Project Scientist and ATST Science Working Group (ASWG) on site requirement specifications*
- *Recommend the initial sites to be tested*
- *Recommend site test procedures and equipment*
- *Review the data reduction methods*
- *Periodically monitor the results*
- *Prepare a report on the site survey results*

The ATST SSWG Final Report (FEIS at Vol. II, Appendix O) summarizes the work of the SSWG in the site selection process. The SSWG Final Report is one of the few comparative studies of solar-observing site characteristics to be carried out with consistent instrumentation and analysis methods and is further explained below.

The SSWG site selection process began with the development of a list of potential sites, with the only constraint being that the candidate sites be reasonably sunny (FEIS at Vol. II, Appendix O, p. 14). The list of candidate sites was then prepared, along with basic geographic and climate data for each site. The SSWG was then required to cull the list down from 72 to six candidate sites because only six sites could be carried forward for testing, due to resource constraints associated with the cost of operating the testing regime for two years, and taking and analyzing the data of the SSWG survey (FEIS at Vol. II, Appendix O, p. 14).

The 72 candidate sites were discussed and debated among the SSWG members. Factors considered for each site during these debates included meteorological conditions such as cloud cover; annual precipitation; prevailing wind patterns; presence of aircraft contrails; site access; availability of utilities; and size of the site relative to the anticipated site plan for the proposed ATST facility. Anticipated costs of building the project on the site were not a factor in these considerations. At the conclusion of these debates, considerations of feasibility and observing conditions as well as, in some cases, changing environmental conditions (particularly drought) revealed in site visits led to the reduction of the list to six remaining candidate sites (FEIS at Vol. II, Appendix O, pp. 1, 14-16).

The final list of six sites to be instrumented for detailed study represented a cross-section of geographical locales: continental mountain (Sacramento Peak, Sunspot, NM), continental mountain lake (Panguitch Lake, UT), peninsula mountain (San Pedro Martir, Baja, CA), coastal

mountain lake (Big Bear, CA), Atlantic island mountain (La Palma, Canary Islands, Spain), and Pacific island mountain (Haleakalā, Maui, HI). Big Bear Lake, La Palma and Sacramento Peak were selected for evaluation because they are homes to well-established and productive solar observatories. Because island sites often demonstrate atmospheric stability, three potential Hawaiian sites (Mauna Kea, Mauna Loa, and Haleakalā) were also evaluated. Mauna Kea was eliminated from further consideration because only one area within the Science Reserve was available and it was revealed from a prior site survey to have poor daytime seeing. ("Seeing" is a term used by astronomers as a measure of the image quality with "excellent seeing" referring to conditions under which the images delivered through the atmosphere are very sharp and "bad seeing" referring to atmospheric conditions that blur the images.) Mauna Loa was eliminated from further consideration because the plot size was too small to accommodate the proposed ATST Project. Panguitch Lake in Utah was chosen as one of the six candidate sites for further study because lake sites are known to have potentially good seeing characteristics. Further, the Panguitch Lake site is located at high-altitude. Finally, San Pedro Martir in Baja California was included since it is a peninsular mountain site in relative close proximity to large bodies of water, which promote less turbulence. Sacramento Peak, with its very well-studied and known atmospheric conditions, served as a control site against from which data from the other sites could be compared. This site was also considered to be a viable candidate based on scientific and feasibility criteria.

After the six candidate sites were identified, the SSWG incorporated a new technique of combined differential image motion and scintillation measurements to estimate the seeing characteristics over a range of heights above each candidate site (FEIS at Vol. II, Appendix O, p. 98). The site survey equipment to assist in site selection identification included "a multi-band miniature coronagraph to estimate sky brightness and water vapor content" (FEIS at Vol. II, Appendix O, p. 98). This resulted in a considerable database of information on the remaining six candidate sites as explained below.

A set of objective criteria was developed to determine which of the six candidate sites would meet the science requirements for the proposed ATST Project. These criteria flowed down from the science drivers articulated in the ATST Science Requirements Document (http://atst.nso.edu/files/docs/SPEC-0001.pdf), released by the ASWG (March 2002). Primary among these criteria were:

1. Two hundred (200) annual hours of excellent "seeing" conditions. (FEIS at Vol. II, Appendix O, p. 12); and,

2. Four hundred eighty (480) annual hours of low sky brightness (defined as less than 25 millionths of the brightness of the solar disk) immediately adjacent to the "limb" of the solar disk (FEIS at Vol. II, Appendix O, p. 14).

The seeing criterion is affected by turbulence in the Earth's atmosphere at all levels. Since solar telescopes operate during the day, a dominant issue is turbulence driven by the solar heating of the ground near the telescope structure. The warm ground heats the air, creating turbulence at low elevation. It is vital that daytime astronomy, such as solar observations, take place in locations that limit these effects. The best way to reduce these "ground effects," as they are

called, is to build the telescope in windy (but not gusty) places near large bodies of water, both of which act to equalize air temperature. The shape of the topography around the telescope site also has a strong influence on the effects of wind and water in reducing ground effects.

The sky brightness criterion is important for studies of the tenuous outermost layer of the Sun's atmosphere, the corona. The corona is intrinsically very faint, significantly fainter than the disk, or photosphere of the Sun. Light from the photosphere scattered by dust or other aerosols in the Earth's atmosphere makes the sky adjacent to the Sun look bright. Accordingly, the brighter the sky, the more difficult it is to study the faint corona, as the coronal light is overwhelmed by the scattered photospheric light.

Additional criteria considered by the SSWG included precipitible water vapor, dust levels, temperature extremes, the feasibility of construction and proximity to support facilities for telescope operations.

In order to assess the criteria, test towers were set up at each of the six sites (e.g., FEIS at Fig. 2-1). These towers were instrumented with devices that measure the overall quality of the seeing, the turbulence in the Earth's atmosphere as a function of height above the ground (i.e., where the seeing is coming from), the sky brightness, dust levels, and meteorological conditions. These instruments collected measurements for 12 to 18 months at each site, allowing a uniform comparison of the sites with respect to the criteria listed above.

As a result of those tests at the six candidate sites, it became clear that the six candidate sites could be divided into two groups based on the observing conditions (FEIS at Vol. II, Appendix O, p. 1). The main scientific goals of the proposed ATST Project require the measurement of the solar magnetic field over extremely small distances on the surface, and the measurement of the magnetic field in the very faint outer solar region known as the corona. To do this, the atmospheric conditions at the site must satisfy two main criteria: a very stable atmosphere with extremely low levels of turbulence, and a very clean atmosphere with extremely low levels of dust. By themselves, these conditions are hard to find, and a site where both conditions are met is extremely rare. The tested sites were found to consist of two groups: one was comprised of three locations (Sacramento Peak, San Pedro Martir, and Panguitch Lake) where the measurements demonstrated that the atmospheric conditions were never of sufficient quality for achievement of the ATST science goals; and the other group consisted of three locations (Haleakalā, La Palma, and Big Bear), where the measurements indicated that conditions might be of sufficient quality over various time periods. The ASWG met in November 2003, and recommended that because of the results, testing be continued only at the top ranking group of sites. The three remaining sites – Big Bear Lake (California), Haleakalā (Maui, Hawai'i), and La Palma (Canary Islands, Spain) – comprised the top ranking group and were tested for an additional year. After this additional testing, La Palma and Big Bear Lake were ultimately found to have demonstrated deficiencies in one or more of the primary scientific evaluation criteria (FEIS at Vol. II, Appendix O, p. 1). The notable characteristics and the deficiencies of the La Palma and Big Bear sites are outlined in more detail in Sections 2.3.3 and 2.3.4 of the FEIS.

Based on the results of both the preliminary testing and the continued testing of the three remaining sites, Haleakalā met or exceeded the primary scientific evaluation criteria. La Palma

was found to meet the requirement for hours of highest-resolution seeing, but was found to be deficient in meeting the required level for one of the primary science outputs — sufficient available hours of dark daylight sky close to the Sun's limb. Big Bear Lake was found to be deficient in meeting the required levels for both of the primary science requirements — sufficient hours of highest resolution seeing and sufficient available hours of dark daylight sky close to the Sun's limb. All three sites met the requirement of access to infrared wavelengths (Objective 3 in FEIS, Section 1.4.2-Purpose of the Project). Because siting the telescope at either La Palma or Big Bear Lake would substantially and irrevocably reduce the telescope's scientific output, and, thus, not meet the purpose and need of the proposed ATST Project, both were eliminated from further consideration. For this same reason – a failure of two of the three remaining sites to meet the required scientific objectives – further analysis was not warranted.

It should be noted that additional public comments were raised about using advanced space technology and considering space-optics, e.g., a space-based solar telescope. The ATST, however, is designed to measure and understand the influence of the outer solar atmosphere on the interplanetary space between the Earth and the Sun. Virtually all of the Sun's dynamic effects on the Earth can be traced back to solar magnetic fields and the ATST would measure these outer fields for the first time. The technology simply does not exist anywhere for doing this measurement from space. While the Japanese/American/British SOLAR-B/Hinode mission looks on the disk of the Sun for solar flares, its mission is complementary to the goals of the ATST. We are many decades away from having the technical capability of launching a solar telescope with the necessary 4-meter mirror, like the ATST, into space to measure these coronal magnetic fields. Meanwhile our global communications and the impact of solar changes on terrestrial climate remain a risk for human civilization while we wait to understand solar cycle variability. For these reasons, this alternative was not carried forward for further consideration.

II. ENVIRONMENTAL COMPLIANCE

A. COMPLIANCE WITH NEPA

The FEIS was prepared pursuant to the National Environmental Policy Act, 42 U.S.C. § 4321, *et seq.* (NEPA), to support NSF's decision on whether to fund the construction and operation of the ATST. Specifically, the FEIS was the final of three environmental documents (the Draft Environmental Impact Statement (DEIS), the Supplemental Draft Environmental Impact Statement (SDEIS), and the FEIS) prepared to evaluate the potential environmental impacts associated with the construction and operation of the proposed ATST Project and those impacts associated with the issuance of a National Park Service (NPS) Special Use Permit (SUP) pursuant to 36 C.F.R. § 5.6 to operate commercial vehicles on the Haleakalā National Park (HALE) road during the construction and operation phases of the proposed Project. The FEIS was also prepared to comply with the State of Hawai'i Chapter 343, Hawai'i Revised Statutes (HRS), Environmental Impact Statements.

On June 23, 2005, a Notice of Intent (NOI) to prepare an Environmental Impact Statement (EIS) for the proposed ATST Project was published in the Federal Register, Vol. 70, No. 120/Notices. In compliance with the State of Hawai'i Office of Environmental Quality Control (OEQC), an Announcement was also published in the OEQC Bulletin on June 23, 2005. Formal notification

letters announcing the intent of the NSF to prepare an EIS for the proposed ATST Project were sent in June 2005, to State of Hawai'i elected officials, organizations, Federal and State agencies, and community individuals. Detailed information regarding three Public Scoping Meetings that were held on Maui in July 2005 was also included in the NOI, the OEQC Bulletin, and the notification letters. Specific public notification and meeting details were provided in the FEIS.

Three pre-assessment Public Scoping Meetings to assist the NSF in determining the scope of the environmental analysis, resources involved, and potential concerns about effects were held on Maui in July 2005. Public Notices were published in both The Maui Weekly and The Maui News. The number of registered participants attending the three Public Scoping Meetings totaled 29 and the number of speakers providing questions or comments totaled 24 (*see* Table 1, below). (The number of registered participants is based on the number of individuals who signed an attendance sheet upon arriving at each meeting. The total attendance was higher than the number of those who registered.) Table 2, below, lists the topics of concern in order of the number of comments expressed by individuals at those meetings.

Table 1. Public Scoping Meetings - Participation

Meeting Location	Registered Participants	Number of Speakers
Cameron Center Auditorium – July 12, 2005	15	6
Kula Community Center – July 13, 2005	7	8
Mayor Hannibal Tavares Community Center – July 14, 2005	7	10

Table 2. Public Scoping Meetings – Topics of Concern, Based on Transcripts

	Topics of Concern	Number of Comments
1	Cultural, Historic and Archeological	7
2	Building Size	5
3	Visual Resources and View Plane	5
4	Employment	4
5	Biological Resources and Endangered Species	3
6	Construction: Color of Building	3
7	Power Requirements	3
8	Education Component	2
9	Communications	2
10	Economic Benefits to People of Maui	2
11	Ceded Lands Issue	1
12	Light Pollution for Night-Time Observing	1
13	Military Component	1
14	Site Alternatives, Site Selection	3
15	Use of Lasers	1
16	Who is the Responsible Agency for the Project	1
17	Infrastructure and Utilities: Roadways and Traffic	1
18	Security as a National Asset	1
19	Space-Based Telescope	1
20	Cost of Project	1
21	Oppose Project	1
22	Need for Project	1
23	Upcountry Community Plan	1

Hawai'i EIS Preparation Notice (EISPN)

During consultation with the State of Hawai'i OEQC, it was determined that an EIS Preparation Notice (EISPN) was needed to address requirements under Hawai'i Revised Statutes (HRS) Chapter 200, Title 11, because the proposed ATST Project may potentially meet one or more of the significance criteria for effects on Conservation District Land. The EISPN was published and distributed in August 2005, to the OEQC, a recommended number of elected officials, agencies and organizations, libraries, and other interested individuals with notification of a 30-day public comment period. A Public Notice announcing the availability of the EISPN was also published in The Maui News and The Honolulu Advertiser.

A total of 46 written comments were received during the 30-day public comment period. The comment letters and responses were provided in the FEIS. Comments received addressed issues similar to those raised during the Public Scoping Meetings. Table 3, below, lists topics of concern in order of the number of comment letters received from the public.

Table 3. EISPN Comment Letters

	Topics of Concern	Number of Comments
1	Cultural, Historic and Archeological	20
2	Visual Resources and View Plane	11
3	Proponent of Project	5
4	Request Information About Project or Documents	5
5	Biological Resources and Endangered Species	4
6	Infrastructure and Utilities: Roadways and Traffic	4
7	Oppose Project	4
8	Construction: Color of Building	3
9	Economic Benefits to People of Maui	3
10	Site Alternatives	3
11	Visitor Experience	3
12	Misinformation Published	3
13	Mitigation and Cumulative Impacts Needed	3
14	Ceded Lands Issue	2
15	Geological	2
16	Need for Summit Master Plan	2
17	Mitigation Suggestions/Proposals	2
18	Building Size	1
19	Employment	1
20	Education Component	1
21	No Impacts Foreseen (by State Agency)	1
22	Infrastructure and Utilities: Wastewater Management	1
23	Coastal Zone Management Area Compliance	1
24	Section 106 Process	1
25	Tours	1
26	Infrastructure and Utilities: Size	1
27	Petitions: Proponents for Project	172
28	Petitions: Oppose Project	33

During the next few months, additional meetings occurred either upon request from the local community or at the request of ATST project members. Informal community meetings that were requested were accommodated with public notification in The Maui News and The Haleakalā

Times, and those in attendance were given the opportunity to ask questions and comment on the proposed ATST Project. All information presented during these additional meetings was identical to that presented at the July 2005 Public Scoping meetings.

DEIS

A DEIS was published in the Federal Register (Vol. 71, No. 172) on September 6, 2006, and in the OEQC Bulletin on September 8, 2006, which analyzed the environmental consequences of two action alternatives (the Mees site and the Reber Circle site, both located within the Haleakalā High Altitude Observatories (HO) site on Haleakalā, Maui, Hawai'i), and a No-Action Alternative. Detailed information announcing three DEIS Public Comment Meetings was also included in the Notices. The DEIS was distributed to Federal agencies and to the OEQC, an OEQC–mandatory and –approved number of State of Hawai'i and County of Maui agencies, organizations, libraries, elected officials, and other interested individuals. The DEIS was also available on the Internet on the ATST website (http://atst.nso.edu). Additional copies of the DEIS were distributed during the following months upon request. The public was given the required 45-day period in which to submit written comments on the DEIS. During this time period, the public was also invited to submit requests to become consulting parties pursuant to Section 106 of the National Historic Preservation Act, 16 U.S.C. § 470f. Notification of three public hearings on the DEIS, which were held in September 2006, on Maui, was published in The Maui News, The Haleakalā Times, and The Maui Weekly-South Edition. The 45-day public comment period ended on October 23, 2006, however, public comments were accepted beyond the deadline.

The number of registered participants attending the three DEIS Public Comment Meetings totaled 73 and the number of speakers providing questions or comments totaled 39 (*see* Table 4, below). (The number of registered participants is based on the number of individuals who signed an attendance sheet upon arriving at each hearing. Total attendance was higher than the number of those who registered.) Table 5, below, lists topics of concern in order of the number of comments expressed by individuals at those meetings.

Table 4. DEIS Public Comment Meetings - Participation

Meeting Location	Registered Participants	Number of Speakers
Cameron Center Auditorium – Sept. 27, 2006	35	20
Mayor Hannibal Tavares Community Center– Sept. 28, 2006	23	9
Kula Community Center– Sept. 29, 2006	15	10

Table 5. DEIS Public Comment Meetings – Topics of Concern, Based on Transcripts

	Topics of Concern	Number of Comments
1	Cultural, Historic, and Archeological Resources	20
2	Site Selection	8
3	Public Meetings	8
4	Visual Resources and View Plane	6
5	Hazardous Materials	4
6	Environmental Consequences and Cumulative Effects	4
7	Biological Resources and Endangered Species	3
8	Infrastructure and Utilities: Electrical	3
9	Education and Public Outreach	3
10	Military Component and Security Implications	2
11	Meeting Transcripts	2
12	Water Resources	2
13	Infrastructure and Utilities: Excavation	2
14	Land Use	1
15	Management Plan	1
16	Noise	1
17	Environmental Justice	1
18	Construction: Building Code	1
19	Infrastructure and Utilities: Roadways and Traffic	1
20	Additional Comments - Senior Review	1
21	Solar Cycle and Decommissioning	1
22	Mitigation Proposals Submitted	1

A total of 62 written comments and 3 types of petitions were received during the 45-day public comment period (*see* Table 6, below). The comments and NSF's responses thereto are included in the FEIS. Comments received addressed issues similar to those raised during the Public Scoping Meetings and to comments received on the EISPN. Table 7, below, lists the topics of concern in order of the number of comments received.

Table 6. DEIS Public Comment Letters

DEIS Comment Letters Received From	Number of Comme t Letters
Federal, State, and County of Maui Agencies	21
Individuals and Community Groups	41
Petitions: 1. Oppose Project	636
2. Oppose Project and Request to be a Section 106 Consulting Party	55
3. Support Project	105

Table 7. DEIS Public Comment Letters – Topics of Concern

	Topics of Concern	Number of Comments
1	Cultural, Historic, and Archeological Resources	32
2	Visual Resources and View Plane	14
3	Biological Resources and Endangered Species	13
4	Infrastructure and Utilities: Roadways and Traffic	7
5	Proposed Action and Alternatives	7
6	HALE Resources and Crater Road	4
7	Infrastructure and Utilities: Electricity	4
8	Meeting Transcripts	4
9	Noise	4
10	Hazardous Materials and Solid Waste	3
11	Infrastructure and Utilities: Maui County Building Codes	3
12	Letters received with no comments to offer	3
13	Management Plan	3
14	Mitigation Proposals	3
15	Significance of Impacts and Mitigation	3
16	Space-based Telescope	3
17	Additional Comments	2
18	Educational and Public Outreach	2
19	Infrastructure and Utilities: ATST Equipment and Infrastructure	2
20	Land Use and Existing Activities: Land Ownership	2
21	Relationship Between Mees and Proposed ATST Project	2
22	Topography, Geology and Soils	2
23	Air Quality	1
24	Conservation District Use Permit	1
25	Construction Activities, Soil Placement	1
26	Employment Opportunities	1
27	Environmental Justice	1
28	Federal Aviation Administration	1
29	General Corrections to DEIS Statements and/or Verbiage	1
30	Infrastructure and Utilities: Communications	1
31	Infrastructure and Utilities: Wastewater, Domestic Water, Stormwater	1
32	Military-Related Component and Security Implications	1
33	Monitoring and Enforcement of Environmental Protection	1
34	Observatory Decommissioning	1
35	Question focused on a single potential benefit of the telescope	1
36	Scoping Meetings	1
37	Supportive of project	1
38	Timing of the NEPA Process	1
39	Unresolved Issues	1
40	Water Resources	1

SDEIS

The SDEIS was prepared in response to public and agency comments on the DEIS published in September 2006. In a number of respects, the SDEIS was considerably revised from the DEIS; comments received on the DEIS warranted additional surveys and studies, which were completed prior to and analyzed in the SDEIS.

The Notice of Availability of the SDEIS was formally published on May 8, 2009, in the Federal Register (Vol. 74, No. 88) and in the OEQC Bulletin. Detailed information regarding two NEPA

SDEIS Public Comment Hearings, held on Maui in June 2009, and a 45-day public comment period were also included in the Notice. This same information was also published in The Maui News, The Honolulu Advertiser, and The Star Bulletin newspapers. The SDEIS was distributed to Federal agencies and an OEQC–mandatory and –approved number of State of Hawai'i and County of Maui agencies, organizations, libraries, elected officials, and other interested individuals. Additional copies of the SDEIS were distributed upon request. Public comments were accepted beyond the 45-day comment period deadline.

The number of registered participants attending the two SDEIS Public Comment Meetings totaled 83 and the number of speakers providing questions or comments, including unidentified speakers, were approximately 43 (*see* Table 8, below). (The number of registered participants is based on the number of individuals who signed an attendance sheet upon arriving at each hearing. Total attendance was higher than the number of those who registered.) Table 9, below, lists topics of concern in order of the number of comments expressed by individuals at these meetings.

Table 8. SDEIS Public Comment Meetings - Participation

Meeting Location	Registered Participants	Number of Speakers
Cameron Center Auditorium - June 3, 2009	37	19
Mayor Hannibal Tavares Community Center - June 4, 2009	46	24

Table 9. SDEIS Public Comment Meetings – Topics of Concern, Based on Transcripts

	Topics of Concern	Number of Comments
1	Cultural, Historic, and Archeological Resources	25
2	Employment	18
3	Need for the Project	8
4	Site Selection	6
5	Decision	6
6	Land Use	4
7	Military-Related Component and Security Implications	4
8	Visual Resources and View Plane	3
9	Visitor Experience	3
10	Management Plan	3
11	Funding	3
12	Education and Public Outreach	2
13	Meeting Transcripts and Comments and Responses	2
14	Construction In General	2
15	Cumulative Impacts	2
16	Biological Resources and Endangered Species	1
17	Infrastructure and Utilities: Electrical	1
18	Upcountry Community Plan	1
19	Hazardous Materials	1
20	Environmental Justice	1

A total of 135 written comment letters, 3,414 e-mail form letters generated through various websites, and 1 type of petition were received during the 45-day public comment period (*see* Table 10, below). The comment letters and responses were provided in the FEIS. Comments

received addressed issues similar to those raised during the Public Scoping Meetings and comments on both the EISPN and the DEIS. Table 11, below, lists the topics of concern in order of the number of comments received.

Table 10. SDEIS Public Comment Letters

SDEIS Comments Received From	Number of Comment Letters
Federal, State, and County of Maui Agencies	16
Individuals and Community Groups	119
E-mail form letters through National Parks Conservation Association website	3,235
E-mail form letters through Kahea website, Subject: In Opposition to Construction on Haleakalā	67
E-mail form letters through Kahea website, Subject: Please Review Alternative Locations	65
E-mail form letters through Kahea website, Subject: Think Before Building on Haleakalā	47
Petitions: "Enough is Enough"	271

Table 11. SDEIS Public Comment Letters – Topics of Concern

	Topics of Concern	Number of Comments				
		Brief Letters	Petitioners	E-mail form letters	Extensive Letters	TOTAL
1	Cultural, Historic, Visual Resources and View Plane, Visitor Use and Experience, impairment to HALE			3,235		3,235
2	Cultural, Historic, and Archeological	15	271		9	295
3	Employment	11	271		1	283
4	Infrastructure and Utilities: Electrical	3	271		1	275
5	Construction: Roadways and Traffic	2	271			273
6	Infrastructure and Utilities: Wastewater, Domestic Water, Stormwater	2	271			273
7	Air Quality		271			271
8	Visual Resources and View Plane and Visitor Use			38		38
9	Site Selection			18	6	24
10	Support of Project	21				21
11	Biological Resources and Endangered Species			12		12
12	Haleakalā National Park (HALE)			10		10
13	Mitigation Proposals Submitted	10				10
14	Biological Resources and Endangered Species	2			7	9
15	Visual Resources and View Plane	3			6	9
16	Visitor Use and Experience	2			6	8
17	Cultural, Historic and Archeological			7		7
18	Land Use	4			3	7
19	Noise	3			4	7
20	Infrastructure and Utilities: Roadways and Traffic	2			4	6
21	Management Plan	5			1	6
22	Mitigation Comments	3			3	6
23	Site Selection	6				6
24	Support for Project			5		5
25	Construction: Building Code	4				4
26	Cumulative Impacts				4	4
27	Education and Public Outreach	4				4
28	Military-Related Component and Security Implications	4				4
29	Purpose and Need			2	2	4
30	Comments Regarding Haleakalā National Park (HALE)	3				3
31	Conservation District, CDUA, CDUP				3	3
32	HALE concerns				3	3
33	Section 106	2			1	3
34	Space-Based Telescope	3				3
35	Complying with NEPA				2	2
36	Construction			2		2
37	Construction In General	1			1	2
38	Cost-benefit Analysis				2	2
39	Environmental Consequences and Cumulative Effects	2				2
40	Hazardous Materials	1			1	2
41	Infrastructure and Utilities: ATST Apron and Paint Color	2				2

Table 11. SDEIS Public Comment Letters – Topics of Concern (cont.)

	Topics of Concern	Number of Comments				
		Brief Letters	Petitioners	E-mail form letters	Extensive Letters	TOTAL
42	Infrastructure and Utilities: Communications	2				2
43	Infrastructure and Utilities: Excavation	1			1	2
44	No comments to offer	1			1	2
45	Support of Project	2				2
46	Upcountry Community Plan	2				2
47	Atmospheric "Seeing"	1				1
48	Environmental Protection Agency Review and Rating	1				1
49	Meeting Transcripts	1				1
50	Meetings	1				1
51	Mitigation: SUP				1	1
52	Need for the Project	1				1
53	Other Comments: Energy from the Sun, Crater Historic District map				1	1
54	Public Meetings/Public Involvement				1	1
55	Public Services and Utilities				1	1
56	Sunspot Cycle and Decommissioning	1				1
57	Use of Mees Facility				1	1

FEIS

After reviewing the comments on the SDEIS received during the public comment period, including those raised during the SDEIS public hearings, NSF prepared an FEIS, which was published on July 24, 2009, and noticed in the Federal Register on July 31, 2009.

Post-FEIS Comments

Following issuance of the FEIS, six comment letters were received. The comments contained in these letters have been reviewed and considered, following are NSF's responses to the comments raised. The first letter, dated July 28, 2009, was from the Plumbers and Fitters Local 475, which expressed support for the project, encouraged the use of local skilled workers, and acknowledged the important role that Hawai'i has in astronomical science and the opportunity that the ATST presents for yielding "further new discoveries." NSF appreciates the letter and intends to use local skilled workers to the extent possible and practical.

The second comment letter, dated August 5, 2009, was from the County of Maui, Department of Planning. This letter, however, was submitted in response to the SDEIS, and not the FEIS. Since, by the time the letter was written and received by NSF, the comment period for the SDEIS had closed and the FEIS was issued, a response to the comment letter could not be included in the FEIS. In the letter, the Department of Planning provided guidance for building the ATST on land with certain designated uses. The issues raised in the letter, however, were already addressed in the FEIS.

On August 14, 2009, the County of Maui, Department of Public Works, Development Services Administration sent a comment letter to NSF indicating that they reviewed the FEIS and had no comments. On August 15, 2009, NSF received an e-mail from Thomas King, Ph.D., questioning how the original 72 sites were chosen. That e-mail initiated a comment and response exchange

with NSF that continued through August 18, 2009. At first, NSF responded to his e-mail suggesting that he review Section 2.0 of FEIS for a thorough discussion of the site selection process. In response to a follow-up message, NSF sent further clarification regarding why the solar physics community considered certain sites but not others. The last question raised by the commenter was whether the FEIS had a discussion about whether inversion layers or elevation criteria factored into how the initial 72 sites were identified. The response to that question is that such criteria was indeed considered in the site selection process as outlined on page 1 of Appendix J to the FEIS (Proposed ATST Project and Alternatives (1) Sites Evaluated for Science Criteria):

In order to identify the site with the best conditions, well-established selection criteria were applied. One leading selection criterion is high-altitude, in order to place the telescope above much of the atmosphere. Since the atmosphere acts as a blurring lens that distorts images, each candidate site was on top of or within mountains that provide adequate elevation above a significant fraction of the atmosphere. Other criteria include:

1. *Surrounding bodies of water to reduce turbulent convection;*
2. *Low humidity;*

* * *

Initially, 72 sites around the world were evaluated with respect to the science criteria above. The list was culled down primarily by considerations of feasibility and observing conditions that meet the aforementioned criteria.

In addition, the SSWG Report (*see* Appendix O, p. 16 of Vol. II of the FEIS) discusses the mathematical formula on which the preliminary site selection was based. The very first term in the formula is "elevation", e.g., the higher the site, the higher the score.

On August 21, 2009, the National Park Service (NPS) sent a letter to NSF commenting on the FEIS. In its comment letter, the NPS raised several concerns. According to the NPS, the most notable of its concerns was the discussion concerning NSF's Section 7 informal consultation with the U. S. Fish and Wildlife Service (USFWS) with respect to the new measures proposed in the FEIS including: 1) the impacts on the nēnē (Hawaiian goose; *Branta sandvicensis)* at the Park's entrance station as a result of the temporarily improved shoulder; and 2) the night-time driving of oversized loads through the Park. The NPS was particularly concerned about whether NSF had obtained the appropriate documentation regarding these issues from the USFWS. In response to this issue, NSF engaged in several discussions with both USFWS and the NPS. Following those discussions, on November 3, 2009, NSF sent a confirming e-mail to USFWS providing its 'no effect' determination regarding the two issues raised in the NPS' letter and one additional issue, concerning a new mitigation measure, designed to reduce noise, that would limit the times for on-site and outdoor ATST-related construction activities. NSF further explained in its e-mail that, based on discussions with NPS, the night-time driving restriction previously requested by the NPS would be altered; the new restriction, designed to further protect the 'ua'u (Hawaiian Petrel; *Pterodroma sandwichensis)*, would only allow wide and heavy loads to traverse the Park road between 12:00 noon and sunset from mid-February to mid-November of each year, and during night-time hours between mid-November and mid-February of each year

(*see also* MIT-6 in Table 17, below). On November 20, 2009, the USFWS sent an e-mail to NSF concurring with NSF's no effects determination regarding these issues.

In its comment letter, the NPS also raised concerns regarding the accuracy of the text of portions of the FEIS, primarily with respect to the response to the comments matrix in Volume IV, Appendix B of the FEIS. In response to this concern, NSF engaged a contractor to do a complete quality control review of all of the responses to comments. The review verified that nearly all responses had been accurate with the exception of the following:

1. On page 24 of FEIS, Volume IV, Appendix B, the response to the letter from the Hawaii Department of Transportation, dated May 22, 2009, inaccurately refers to Table 1-4; it should be Table 1-5.

2. On page 38 of FEIS, Volume IV, Appendix B, the response to the comment letter from R. Miller, dated June 4, 2009, inaccurately referred to section 1.4.1, when it should have been to section 2.2. Likewise, the reference to section 4.19 later on in the response should have been to section 4.18.

3. The response to comment #4 in the letter from Kilakila 'O Haleakalā, dated June 5, 2009, inaccurately referenced Table 4-13, when it should have referenced Table 4-7.

4. The responses identified in the August 21, 2009, NPS letter as being inaccurate were, indeed, inaccurate. The comments and responses provided in Volume IV of the FEIS are provided below, along with the result of the quality control review:

a. NPS Comment: *#7. 3-46/3.6 The NPS notes that (Office of Management and Business) OMB approval was not given for the visitor survey. It was explained to the NPS that OMB issued a waiver for this survey. We believe that the waiver should be referenced and included in an appendix of the EIS.*

NSF Response: *#7. A "waiver" was not issued. Via e-mail correspondence with NSF, the OMB "determined that the survey that was conducted is outside the scope of the PRA [paperwork reduction act]." This e-mail has been referenced in Section 3.6-Visitor Use and Experience.*

Quality Control Review Result: The text did not mention a waiver or provide an OMB reference. These should have been included. It was, however, listed and defined in Section 7.0-References (p. 7-11) of the FEIS under "OMB", as follows:

"OMB [Office of Management and Budget]. 2008. E-mail correspondence from Amanda Lee, OMB (November 13, 2008) to Tony Gibson, NSF Senior Legislative Policy Analyst (November 12, 2008), regarding use of 2007 Visitor Survey conducted outside HALE. OMB "determined that the survey that was conducted is outside the scope of the PRA [paperwork reduction act]."

b. NPS Comment: *#8. 3-47/3.6 The text incorrectly cites information from NPS visitor surveys and studies. The NPS visitor survey conducted in 2000 by the University of*

Idaho is not the same as the NPS study conducted between 2007 and 2008 (Lawson et al 2008) about backcountry visitor use. The EIS should include the information from the 2000 NPS visitor survey about the primary reasons visitors visit the summit area of the park: 1) sightsee/scenic driving and 2) watching sunrise. The 2000 NPS visitor survey also provides information that the most visited areas in the summit area of the park were the Pu'u Ula'ula Overlook and the Haleakalā Visitor Center.

NSF Response: *#8. Text has been added to this effect in Section 3.6. The reference to Lawson et al., 2008 was added to the 2007/2008 survey in the previous paragraph and omitted from the paragraph that discusses the 2000 survey.*

Quality Control Review Result: The NPS has correctly commented that the references to the two NPS visitor surveys and studies on page 3-48 of the FEIS are improperly referenced. NSF should have cited to the 2008 Lawson study in the relevant paragraph on page 3-48 of the FEIS, when discussing the experience of backcountry campers and cabin users. NSF should have cited to the 2000 study conducted by the University of Idaho to explain that the primary reasons visitors visit the summit area of the Park are to sightsee, engage in scenic driving, and to watch the sunrise.

c. NPS Comment: *#9. The following information from the 2009 FHWA report should be added to the EIS (page 30) "The factors that will most significantly impact the [park] roadway and result in damage will be if the estimated ATST construction traffic is much higher than anticipated and the construction vehicle loading exceed legal load limits." The data about culverts with the least amount of cover is incorrect. Table 8 of the 2009 FHWA report states two culverts (Site #26 and 68) have very little cover.*

NSF Response: *#9. Section 3.9.5-Roadways and Traffic has been updated to reflect this comment. That statement from the FHWA report, along with additional citation to put it in context, has been added to the text. The statement about the culverts has been expanded to include reference to the other culvert identified by the FHWA.*

Quality Control Review Result: The text was added to reflect the comment, but the specific information was not provided; rather, reference to the FHWA report is provided in the text.

d. NPS Comment: *#13. 4-8/4.2.2 The statement "Although not nearly as prevalent, there was testimony in support of the proposed ATST Project, in most instances, supporters strongly rallied for education of Hawaii's youth and the possible opportunities that such a facility might bring to Native Hawaiians." should be deleted. This statement is argumentative and unsupported in the SDEIS. This statement is advocating for the project rather than analyzing the impacts.*

NSF Response: *#13. The sentence has been deleted from this section.*

Quality Control Review Result: The sentence was inadvertently included and not deleted as represented.

e. NPS Comment: *#17. 4-12/4.2.2 The Historic Resources subsection for the Mees Site analyzes the impacts to the park road corridor solely on the amount of traffic-related to the proposed ATST project. The analysis is incomplete and does not taken into consideration the impacts from construction vehicles exceeding legal load limits and wide loads that could increase the probability of accidental damage to the bridge which were also mentioned in the 2009 FHWA report. The measures required by HALE for the issuance of the SUP, such as restrictions on load limits and wide loads, mitigates these impacts to minor, adverse, and short-term.*

NSF Response: *#17. The text has been revised based on comments.*

Quality Control Review Result: The text addresses wide loads, but not legal load limits.

f. NPS Comment: *Measures required to mitigate impacts to the park road corridor as a historic resource are not included in the text of the FEIS as stated in your response to our comment (Appendix B, p.136, #75).*

Quality Control Review Result: These measures were included in the FEIS at section 4.2.2, pages 4-13 and 4-15; section 4.18, pages 4-228 and 4-231; MIT- 6; MIT-8; and MIT-12.

Other than the errors in the comment/response matrix identified above, the quality control review confirmed the accuracy of the comment/response matrix in Appendix B of Volume IV of the FEIS. NSF apologizes for the errors that did occur.

The NPS also raised a concern that NSF did not reference the previously agreed upon mitigation measures limiting the number of vehicles carrying heavy and wide loads to 25 in the FEIS. This reference was, however, made on page 4-192 of the SDEIS, but was not included in the FEIS based on NSF's understanding of the comments received from the NPS on the SDEIS. Nevertheless, to clarify that this restriction is among the mitigation measures agreed upon between the NPS and NSF, language to that effect has been added to MIT-12 in Table 17, below.

Likewise, the NPS commented that clarification was needed regarding the role of the mitigation measures recommended by the Federal Highways Administration (FHWA) in its March 2009 Road Report for inclusion in the SUP. Based on several conversations with the NPS, NSF understood that NPS had already considered and included the FHWA's recommendations in the mitigation measures agreed to between the NPS and NSF to date. NSF further understood, however, that additional mitigation measures might be added by the NPS before the SUP is issued. This is the basis for NSF's discussion on pages 4-14 and 4-15 of the FEIS.

In its August 21, 2009 letter, the NPS also takes issue with NSF's inclusion of only a qualitative analysis in the FEIS to determine impacts to viewsheds and visual resources, and removal of the previously included quantitative analysis, which appeared in the SDEIS. NSF understood, however, from the NPS' earlier comments on the SDEIS, that the quantitative analysis should be removed from the FEIS; accordingly, NSF contracted to have a qualitative analysis conducted. While the outcome of the qualitative analysis was that there would be only moderate adverse impacts to viewsheds and visual resources as a result the ATST, NSF acknowledges that the

quantitative analysis did reveal that there would be major adverse impacts. Moreover, NSF, in section 4.6 of the FEIS, did acknowledge that the visual effects from construction and operation of the ATST would result in major, adverse impacts to the visitor experience within the Park. Accordingly, in consideration of both the quantitative and qualitative analyses and the comments of the NPS and others, NSF agrees that the construction and operation of the ATST will have major adverse short-term and long-term impacts to visual resources and view planes within key areas of the Park that will thus result in major adverse impacts to the visitor experience within the Park.

Finally, the NPS, in its FEIS comment letter, again takes issue with the visitor experience survey, contending that the survey instrument used was flawed. This is a comment that the Park has made several times throughout the NEPA process. While NSF fully respects the views of the NPS, NSF has found the information derived from the visitor experience survey to be of some value. Regardless of the outcome of that survey, however, NSF did determine in the FEIS that there would be major, adverse, long-term and short-term impacts to the visitor use and experience within the Park. (NSF further notes that the NPS' comment that the visitor experience survey was conducted without complying with 44 U.S.C. § 3501, *et seq.*, and the accompanying regulations are not accurate. As indicated in an e-mail exchange between NSF and OMB – that was shared with the NPS – the visitor survey did not violate the Paperwork Reduction Act because it was not carried out or directed by NSF.)

The final comment letter on the FEIS received by NSF was sent on August 24, 2009, by the State of Hawaii Department of Defense, Office of the Director of Civil Defense. In its letter, a general concern was expressed about impacts to cultural, historical, and archeological resources, however, the Office of the Director of Civil Defense deferred to the Department of Land and Natural Resources (DLNR) regarding the practicality of the proposed mitigation measures. NSF notes that the State Historic Preservation Division of the DLNR signed the Programmatic Agreement developed under Section 106 of the NHPA to address adverse impacts to cultural, historical, and archeological resources.

The topics of concerns raised in the FEIS comment letters discussed above are summarized in Table 12, below.

Table 12. Comment Letters Received After Publication of the FEIS - Topics of Concern

Date	Received From	Topics of Concern
07-28-2009	Plumbers and Fitters Local 675 Reginald Castanares, Jr. Business Manager	Support of ATST Project. Economic interest with offer of a skilled local workforce.
08-05-2009	County of Maui, Dept. of Planning Clayton Yoshida, AICP, Planning Program Administrator	Comments submitted were to the SDEIS. The following may affect the project if not located on State Conservation District land: 1. Makawao-Pukalani-Kula Community Plan: a. Prepare a summit master plan. b. Limit building height not to exceed 35 feet above grade. 2. If project is located on State Agricultural land: Special Use Permit or District Boundary Amendment/Zoning Change may be required.
08-14-2009	County of Maui, Dept. of Public Works Development Services Administration Milton Arakawa, AICP, Director of Public Works	No comments at this time.
08-15-2009	Thomas King, Ph.D. (sent via e-mail)	Site alternatives.
08-21-2009	Dept. of the Interior National Park Service Jonathan Jarvis, Director, Pacific West Region	HALE issues.
08-24-2009	State of Hawai'i Dept. of Defense, Office of the Director of Civil Defense	Concerned about impact of cultural, historic, and archeological resources, but defer to DLNR as to proposed mitigation measures.

Alternatives Considered

As discussed above and detailed in the FEIS, many alternative sites were considered for the ATST, but were not carried forward due to their failure to meet the scientific objectives. Furthermore, as explained earlier, the process for identification of scientifically viable sites set forth above was not intended to select one specific site. When the process started, it was unknown whether the application of the scientific criteria developed by experts in the field would ultimately result in the identification of one site, no sites, or multiple scientifically-viable sites. Because it was unknown which, if any, site would meet the science requirements necessary to fulfill the purpose and need of the proposed ATST Project, NSF did not begin its formal environmental reviews under NEPA and the National Historic Preservation Act (NHPA) until after it was determined whether there were any scientifically-viable sites.

As explained earlier, the scientific community began its search for a viable site for the ATST with an original list of 72 potential sites, which was refined down to six. Those six remaining sites were instrumented for further, detailed study (FEIS, Section 2.2-Site Selection), and based on the result of those tests, three sites were clearly deficient and were, therefore, eliminated. The three remaining sites were studied in more detail — Big Bear Lake (California), Haleakalā (Maui, Hawai'i), and La Palma (Canary Islands, Spain). Upon review of the site survey final report, the NSF identified notable reductions of the primary science output were identified for

two of the candidate sites, La Palma and Big Bear Lake. The two deficiencies that would most impact the primary science output are substantially insufficient hours of highest resolution seeing and insufficient available hours of dark daylight sky close to the Sun's disk. These unacceptable levels of hours for high quality observations at the Big Bear Lake and La Palma candidate sites are summarized in Table 13, below.

Table 13. Summary of Annual Hours of Acceptable Seeing and Sky Brightness

Requirement	Big Bear Lake	Haleakalā*	La Palma
200 annual hours of excellent seeing	136 - *FAIL*	399 - *PASS*	225 - *PASS*
480 annual hours of sky brightness less than 25 millionths of the brightness of the solar disk	2 - *FAIL*	1004 - *PASS*	384 - *FAIL*

*Haleakalā is included in the table for reference and, as shown, meets both the criteria for the primary science output — annual required hours of good seeing and dark skies.

The extensive process for identifying scientifically-viable locations for the proposed ATST Project outlined above and explained in detail in the FEIS resulted in two sites located within HO, which led to the identification of two action alternatives to be carried forward for analysis under NEPA. Again, the result could have been that there were no scientifically-viable sites or multiple ones, but in this case, it turned out that the only scientifically-viable locations were at Haleakalā within HO.

The site of the preferred action alternative is located near the existing Mees Solar Observatory (MSO) facility and is referred to in the FEIS as the "Mees site." The Alternative site is located at the only other identified and currently unutilized site within the Haleakala High Altitude Observatory Site (HO) boundary large enough to accommodate the telescope. This alternative site is the previous location of a radio astronomy experiment, referred to at HO as "Reber Circle," and is referred to in the FEIS as the "Reber Circle site."

The Preferred Mees Site Alternative

Under the Preferred alternative, the Mees site, the ATST would be constructed and operated using a reflecting Gregorian-type telescope that would deliver images of the Sun and the solar corona to instrument stations mounted on the telescope and on a rotating platform located below the telescope. The proposed ATST facilities would include:

1. The observatory facility, which includes the telescope, its pier, and the rotating instrument platform;
2. The telescope enclosure;
3. The Support and Operations Building (S&O Building) adjacent to the observatory;
4. A Utility Building attached to the S&O Building by an underground utility chase;
5. Parking for the facility as a whole; and,
6. Modifications to the existing MSO facility.

The entire facility would include approximately 43,980 square feet of new building space (including the telescope enclosure), within a site footprint of 0.74 acres. Figure 1, below, shows the layout of the site of the proposed ATST Project at the Preferred Mees site location, and Figure 2, below, provides an aerial rendering of the site.

Figure 1. Proposed ATST Project at the Mees Site

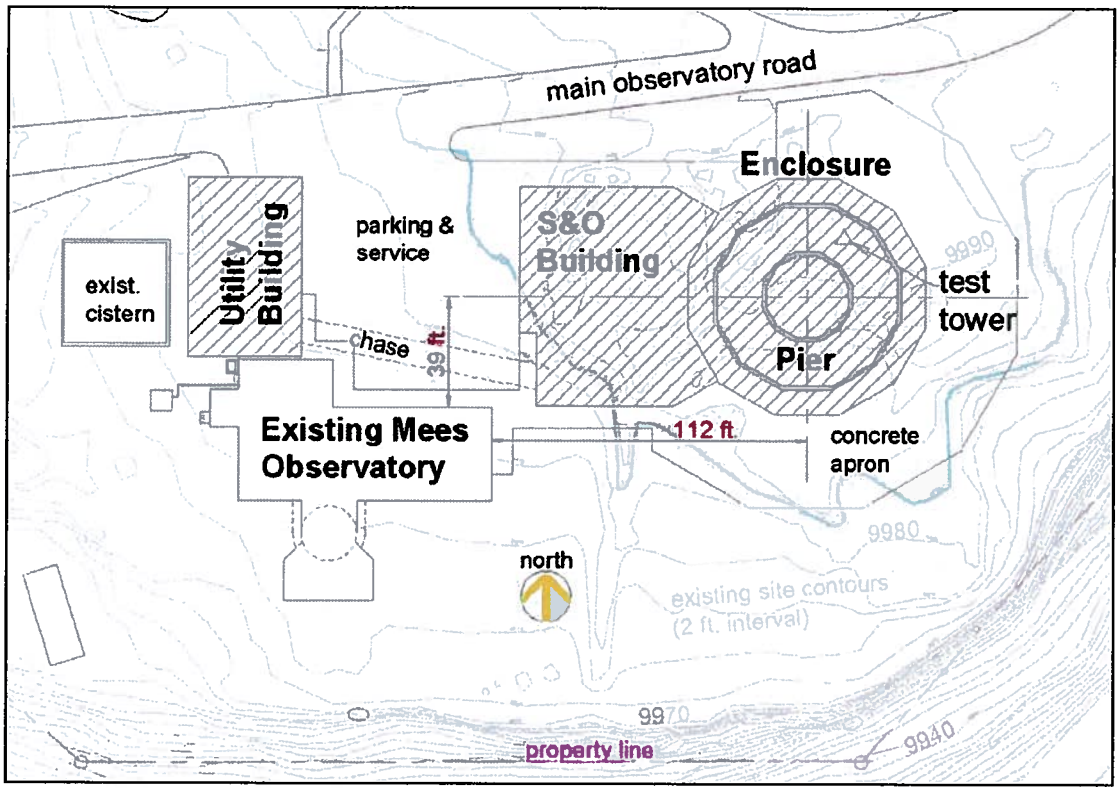
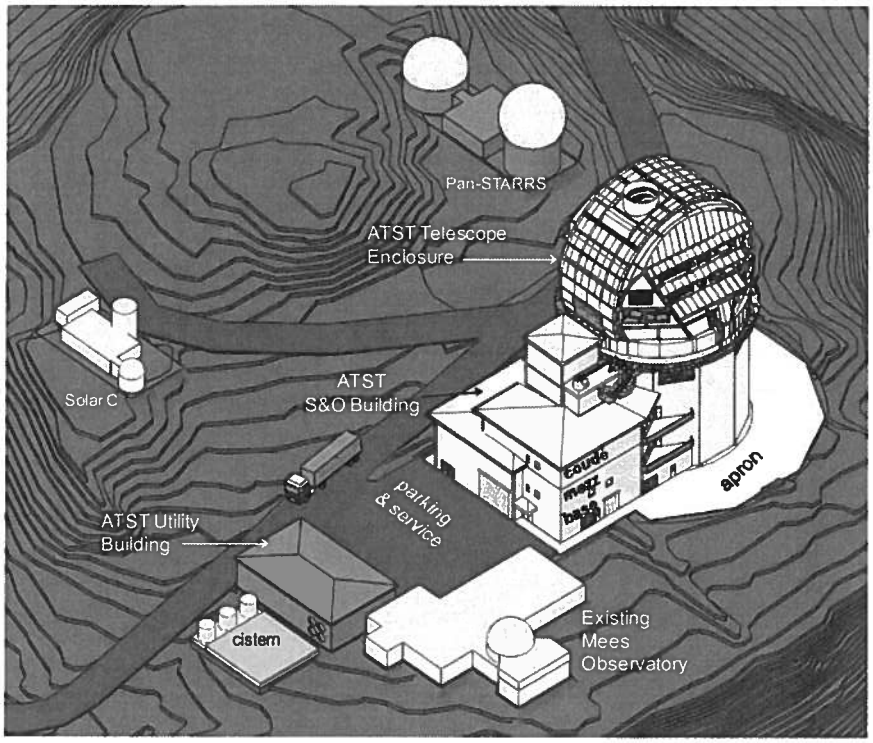


Figure 2. Aerial Rendering of Proposed ATST Project



To achieve the image resolution dictated by the science requirements, the primary light-collecting mirror (M1) of the telescope would require a minimum clear aperture diameter of 4 meters. The distance between the M1 and the secondary mirror (M2) — the overall length of the telescope mount — together with the M1 diameter and off-axis mounting, effectively establishes the swing radius and the required dimensional clearance of the telescope (in altitude and azimuth) and the size of the enclosure required to protect it. These parameters are fundamental to the determination of the necessary height and width of the telescope enclosure.

Following the selection of the Haleakalā site and the consideration of the typical variation of turbulence with height above the ground, the proposed height of the telescope — defined as the distance from ground level to the rotational center of the telescope — was established to be 28 meters (92 feet). This was determined to be the minimum height at which the image resolution required to meet the specified science goals could be achieved. This would dictate an observatory structure that is 43.5 meters (142.7 feet) in height and 25.6 meters (84.0 feet) in diameter.

The S&O Building would be a multi-story structure attached to the lower enclosure, which accommodates observing-related activities that require direct adjacency to the telescope. It would contain a large docking bay with a 20-ton crane, equipment and equipment storage, telescope maintenance facilities, offices and workrooms, laboratories, and the control room for the telescope. The S&O Building would also contain the large-scale platform lift (elevator) needed to move telescope parts between levels. The equipment in the building would include a

hydrostatic oil pump, hydrostatic oil tank, helium compressor, vacuum pump, and liquid nitrogen tanks.

The Utility Building would be a rectangular, steel-framed, metal structure that would provide space for mechanical and electrical equipment that requires complete thermal and vibration isolation from the telescope. The Utility Building would be connected to the S&O Building by an underground utility chase. A preliminary list of the equipment to be housed in the Utility Building includes: a 300 KVA generator and associated automatic transfer switchgear, an 80-ton low-temperature chiller, a 15-ton very-low-temperature chiller, a 10-ton heat pump condenser unit, 2 ventilation fans, an air compressor, a vacuum pump, and 3 uninterruptible power supply units. Because this equipment generates significant levels of audible noise, sound-abatement devices would be built into the equipment, and the walls and roof of the Utility Building would incorporate effective sound blocking materials. An electrical transformer and 3 ice storage tanks would be located outside, adjacent to the Utility Building.

Additional facilities associated with the telescope facility would include the following (*see* FEIS, Vol. II, Appendix J(4)-Supplemental Description of ATST Equipment and Infrastructure for more details on these utilities features.):

1. A grounding field consisting of a series of shallow trenches around the facility and fanning out to the south of the S&O Building filled with conductive concrete or coke breeze (a granular material with high conductivity) to safely provide an electrical ground for the observatory, which is in an environment with a high risk of lightning strikes.

2. A wastewater treatment plant with a capacity of 1,000 gallons/day and an associated infiltration well, designed in compliance with Hawai'i Department of Health regulations.

3. A stormwater management system including gutters, catchment drains, an underground tank, and pipes connecting it to the cistern at the MSO facility.

4. A new electrical transformer next to the Utility Building.

5. A diesel generator for use in case of power outages.

With the exception of the Utility Building, the rest of the proposed ATST facility would be white in order to reduce heat absorption, which would adversely affect telescope operations by heating the adjacent air and thereby introducing turbulence that would degrade the seeing. (*See* FEIS, Vol. II, Appendix J(4)-Supplemental Description of ATST Equipment and Infrastructure for further discussion on these features.)

During the investigation of potential road and traffic issues, the current configuration of the existing entrance station for HALE was identified as a restriction to wide truck loads. The conveyance of large unitary pieces of the ATST telescope, the primary mirror in its protective crate, and other constituent elements of the proposed ATST Project would require truck loads of up to 32 feet 10 inches in width. The HALE entrance station currently provides one paved driving lane approximately 12 feet wide on both the entrance and exiting sides.

Development by ATST engineers of alternative proposals for wider clearance and subsequent consideration by HALE staff identified a mutually preferred option to widen and improve the shoulder on the entry (uphill side) of the entrance station. This would consist of installing compacted fill and a gravel driving surface out to a maximum distance of approximately 12 feet beyond the existing paved roadway at the widest point, and tapering back to the roadway on each end, so as to provide a widened, drivable lane capable of supporting the widest and heaviest of the anticipated ATST loads. Other requirements of this proposed ATST Project would include protecting underground utilities, relocating an existing light pole, upgrading utility pull boxes to withstand the anticipated loads, and other related work.

Specific stipulations with regard to this entrance station work have been formulated by HALE staff and further elaborated by the ATST engineering team:

1. The ATST Project would assure that the septic system is adequately protected. Metal plate covers, grade beam structures or similar protective devices would be deployed. If protection proves impractical, relocation of the septic tank could be considered as an option.

2. The ATST Project would protect the existing utility man-hole covers, including the following measures:

    a) avoid direct axle loading on the covers,
    b) replace the existing covers with heavier gage steel; or,
    c) reinforce the existing covers with additional steel bracing.

3. The ATST Project would ensure that the improved shoulder would be adequate for the heavy loads anticipated by ATST engineers.

4. Periodic maintenance of the widened shoulder area, such as recompaction, regrading, etc., as necessitated by settling, erosion, or washout, would be the responsibility of the ATST Project.

5. A barricade system, such as a gate, removable bollards or similar devices, would be installed by the ATST Project on the widened shoulder to deter Park visitors and staff from driving on it.

6. This area contains native plants and is nēnē habitat. Widening of the shoulder would be completed outside the nēnē nesting season, which is November through March. Native plants would be protected by the ATST Project team, when possible, with the guidance of the HALE staff.

7. When the widened shoulder is no longer needed for the proposed ATST Project, it would be required to be fully restored and rehabilitated. The ATST Project team would consult with HALE staff and would review and approve the final restoration/rehabilitation plan.

Best Management Practices: A variety of best management practices (BMPs) (required practices established in the Long Range Development Plan (LRDP) for HO and policies reflecting public consultation during the EIS process) would be implemented during construction, in order to prevent damage to the natural and cultural environment. These BMPs would include the following:

1. Implementation of the Stormwater Management Plan (SWMP), specific to HO, which is included in the FEIS as Appendix L. This would include all BMPs in Sections 3.1 and 3.2 of Appendix L for recommended construction practices and stormwater control.

2. During construction, temporary diverters and hard surfaces would be utilized to direct surface water flow to the existing stormwater drainage system. As soon as possible, permanent gutters and leaders would be installed on the buildings to capture rainwater and direct it to the underground cistern.

3. Portable toilets with containment tanks would be utilized during early construction work. As soon as possible, a permanent wastewater treatment facility would be installed, which uses aeration and biologically accelerated treatment techniques that achieve effluent standards acceptable for infiltration back to groundwater.

4. Cultural resources monitoring during all leveling and excavation activities in order to prevent damage to undiscovered cultural resources.

5. Using native soils to fill holes upon completion of construction, and replanting grounding trenches, other excavated areas, and soil deposition areas with native vegetation to prevent erosion.

6. Scheduling deliveries of concrete and other materials at times that minimize conflict with tourist traffic on the Park road to Haleakalā.

7. Using signage at the project site and along the roadways to ensure vehicle, pedestrian, and bicycle safety during construction.

8. Dust control would be done by watering the disturbed ground using non-potable water trucked to the site by the contractor specifically for that purpose. Potable water would not be used for dust control.

The Alternative Reber Circle Site

As an alternative to the Preferred Mees site described above, the proposed ATST Project could be constructed on the other unutilized site within HO boundaries. This alternative site is, as described above, the previous location of a radio astronomy experiment referred to as Reber Circle. The principal area of this site is currently unutilized and is the only other area identified at HO that would be large enough to accommodate the proposed ATST Project.

The Reber Circle site is northeast of the Preferred Mees site and is about 6 meters (20 feet) higher in elevation. It is currently bounded by the two Panoramic-Survey Telescope and Rapid

Response System (Pan-STARRS) facilities (PS-1 and PS-2) to the south, the Airglow facility to the south, and the Zodiacal Light facility to the southwest. As discussed in the FEIS at Section 2.3-Alternatives Eliminated from Further Consideration, the site selection process for the proposed ATST Project determined that Haleakalā is the only location that meets the scientific objectives for the proposed ATST Project, and both the Preferred Mees site and the Reber Circle site would fulfill all the science criteria for the ATST.

Most of the critical construction characteristics of the proposed ATST Project would be the same for the Reber Circle site as for the Mees site. The proposed design of the telescope, instruments, and associated buildings is essentially the same as described for the Mees site, however, at the Reber Circle site, a new above ground fuel storage tank to support the back-up generator would be required, which would comply with all applicable EPA and safety regulations. Figure 3, below, shows the layout of the site of the proposed ATST Project at the Alternative Reber Circle site, and Figure 4, below, provides an aerial rendering of the Reber Circle site.

Figure 3. Site Layout of Proposed ATST Project at the Reber Circle Site

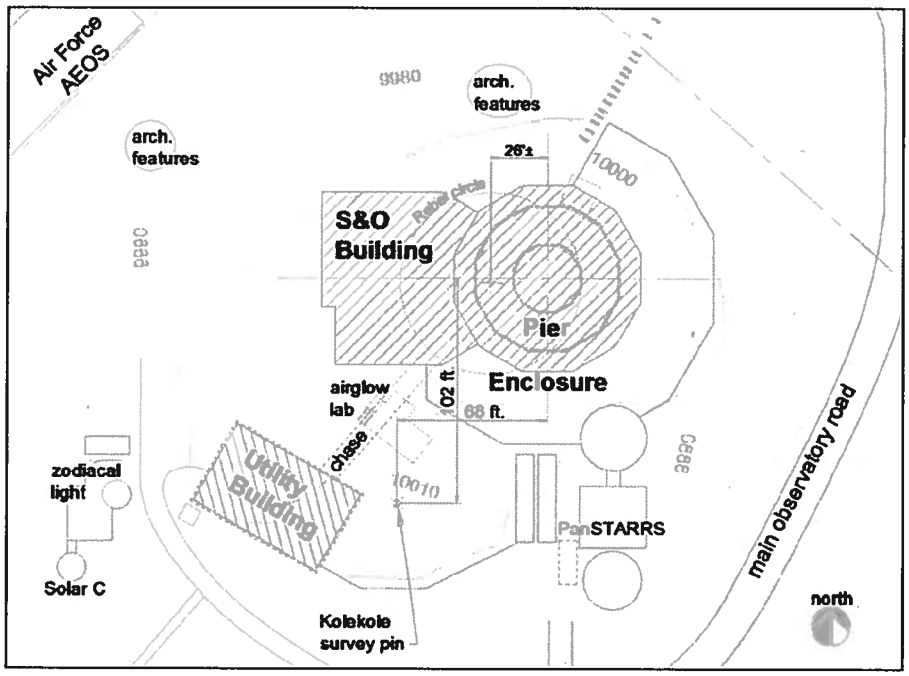
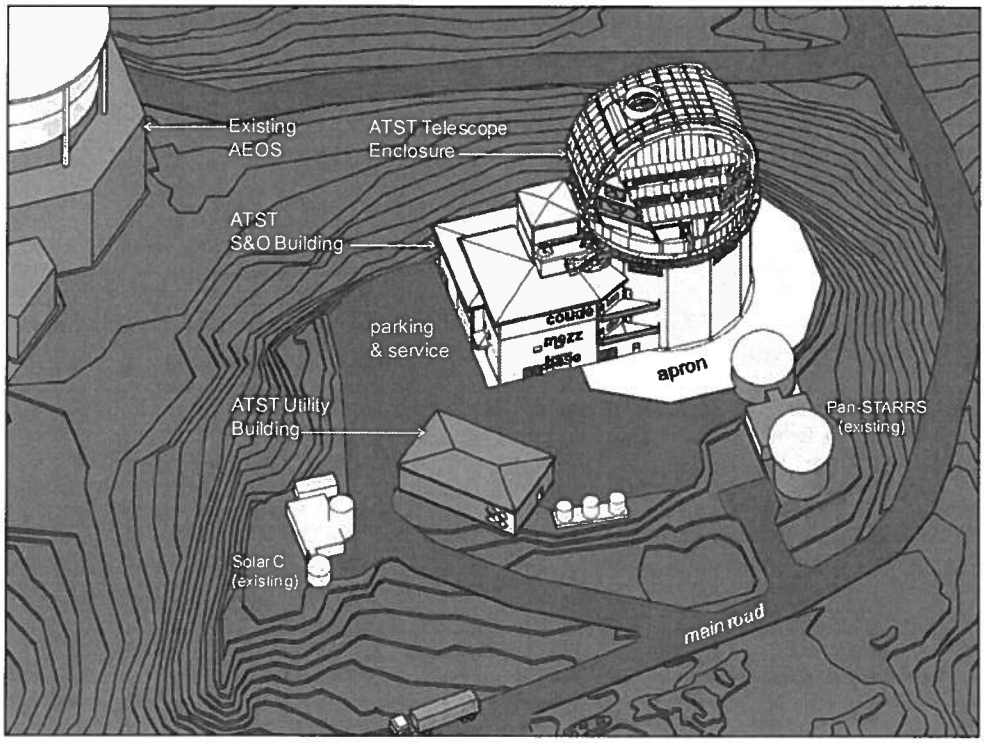


Figure 4. Aerial Rendering of Proposed ATST Project at the Reber Circle Site



The same BMPs (required practices established in the LRDP and policies reflecting public input during the EIS process) would be implemented during construction at the Reber Circle site, the same as it would be during construction at the Mees site.

No-Action Alternative

Under the No-Action Alternative, the ATST would not be funded by NSF for construction, and both the Mees and the Reber Circle sites would remain available for future development of other projects within the Conservation District of HO.

B. ENVIRONMENTAL IMPACTS

The FEIS contains a detailed analysis of the environmental impacts associated with each action alternative and the No-Action Alternative. A summary of the impacts provided in the FEIS is set forth below.

Land Use and Existing Activities

If implemented at either the Preferred Mees site or at the Alternative Reber Circle site, the ATST Project would have a minor, adverse, and long-term direct impact on current land use and existing activities at HO. No mitigation would be necessary, however, NSF would implement MIT-1 (Decommissioning and Deconstruction) to divest itself of the facility at the end of the ATST lifetime (approximately 50 years after operations commence), providing an opportunity to

restore the land to its existing condition, unless otherwise decided in consultation with the Native Hawaiian community.[3]

There would be a major, long-term impact on the existing Federal Aviation Administration (FAA) Remote Communications Air/Ground (RCAG) facilities that could result in signal attenuation from those facilities due to physical obstruction by the ATST structures if the ATST project is built at either location. To address any potential issue involving degradation of communications as a result of the proposed ATST Project, mitigation would include the erection of high-gain antennas at the current location of the RCAG towers (MIT-2). This would reduce the impacts to negligible, adverse, and long-term.

There would be no impact on HALE land use, including along the Park road corridor. Also, the ATST, if constructed at either location, would comply with all Federal, State, and HO land use planning. The ATST Project would be built on State Conservation land, and, pursuant to county regulations, is, therefore, exempt from Maui County building codes. In addition, the proposed ATST Project would not be subject to Chapter 2.80A, of the Maui County Code, pertaining to the General Plan and the community plans. The Makawao-Pukalani-Kula Community Plan as adopted through Ordinance No. 2510, Objective No. 8, recommends a two-story or 35-foot height limitation throughout the region. As noted in the plan, however, HO is in a Conservation District and, thus, is not subject to such restrictions.

Under the No-Action Alternative, the proposed ATST Project would not be built and the land use and existing activities at HO would continue to function in its current configuration.

Cultural Resources

Construction and operation of the ATST Project at either the Preferred Mees site or the Alternative Reber Circle site would result in major, adverse, short- and long-term, and direct impacts on the traditional cultural resources within the Region of Influence (ROI). No indirect impacts would be expected to occur. Mitigation measures would be implemented, and while helpful, they would not, however, reduce the impact intensity to moderate: impacts would remain major, adverse, long-term, and direct. Mitigation measures during construction include: MIT-4 (Sense of Place training), MIT-5 (Cultural Monitor), and MIT-13 (Noise). Mitigation measures for operation of the ATST include: MIT-1 (Decommissioning), MIT-3 (Locate an area for a Hawai'i star compass), MIT-14 (Paint), MIT-16 (Exterior Design), MIT-18 (Rename roads at HO), MIT-15 (Additional Telescope Time), and MIT-17 (MCC Educational Program). Additional mitigation measures set forth in the Programmatic Agreement (PA), prepared pursuant to Section 106 of the NHPA, would also be applied. (*See* PA attached hereto as, "Attachment A.")

Impacts on cultural resources within the Park road corridor associated with construction and operation activities of the ATST Project at either the Mees site or the Reber Circle site are expected to be negligible, adverse, long-term, and direct. No indirect impacts are expected. Mitigation measures associated with noise and traffic include: MIT-6 (SUP requirements). Implementation of this measure, which would limit the levels, hours, and, thus, the noise of

[3] References to "MIT-1" through "MIT-18" throughout this section refer to the specific mitigation measures set forth in the Mitigation Table found on pages 4-227 through 4-232 in Vol. I of the FEIS, and reprinted below.

construction-related traffic along the Park road corridor would maintain the level of impacts at negligible, adverse, long-term, and direct impacts on cultural resources.

Under the No-Action Alternative, the presence of the existing facilities at HO would continue to result in major, adverse, long-term, and direct impacts to the summit as a traditional cultural property. No indirect activities associated with selection of the No-Action Alternative would result. Likewise, under the No-Action Alternative, there would be no increase in traffic within the Park road corridor as a result of the construction and operation of the proposed ATST Project, and, thus, no direct impacts on cultural resources would result within the Park road corridor.

Historic Resources

There would be negligible, adverse, long-term, and direct impacts from the construction and operation of the ATST Project at the Preferred Mees site. No indirect impacts would be expected, and no mitigation would be required. NSF does note that, although NEPA does not require the removal of the Reber Circle remnant of the radio telescope experiment if the ATST were constructed at the Preferred Mees site, Section II. H. of the PA does require its removal subject to the approval of the University of Hawai'i Institute for Astronomy (IfA), and in accordance with the documentation requirements set forth by the State of Hawai'i.

There would be major, adverse, direct, and long-term impacts on historic resources from the construction of the proposed ATST Project at the Reber Circle site. Implementation of MIT-8 (removal of the concrete ring remnant of the radio telescope experiment), however, would reduce the level of impacts to minor, adverse, long-term, and direct. Operation-related activities at either site would be negligible, adverse, long-term and direct.

Within the Park road corridor, there would be moderate, adverse, long-term, and direct impacts on historic resources associated with the construction-related activities for the proposed ATST Project regardless of whether it were built at either the Preferred Mees site or Reber Circle site. Mitigation measures MIT-6 (Noise), MIT-7 (SUP requirements), and MIT-12 (Construction-related traffic) would be implemented during construction, which would reduce the impacts down to minor, adverse, short-term, and direct.

Under either the Preferred Mees site alternative or the Reber Circle Alternative, minor, adverse, and direct long-term impacts to historic resources along the Park road corridor would result from operation-related activities. No indirect impacts would be expected. Direct impacts would be a result of a relatively small increase (1.4 percent) in traffic associated with additional staff needed for the operation of ATST. According to the HALE Road Report, this slight increase would have little measureable impact on traffic or wear to the Park road corridor, including the historic bridge and box culverts. No mitigation measures are anticipated to be implemented; some mitigation measures, however, may ultimately be added as part of the SUP.

Under the No-Action Alternative, there would be no impacts on historic resources within the ROI.

Archeological Resources

There would be negligible, adverse, long-term, and direct impacts on the archeological resources at HO and within the Park road corridor from construction and operation of the proposed ATST Project. This would be the same result if the proposed Project were built at either the Preferred Mees site or the Reber Circle site. Under the No-Action Alternative, there would be no impacts on archeological resources within the ROI.

Biological Resources

Under both action alternatives, botanical species would be removed during construction, but there would be no loss of any endangered or threatened species. Construction of the ATST would have negligible, adverse impacts on the ʻahinahina (silversword; *Argyroxiphium*) population at HO and elsewhere within the ROI under either action alternative. Programmatic monitoring shown in Table 14, below, would, nevertheless, be implemented under either action alternative to ensure that impacts on botanical species would be reduced.

Potential major, adverse impacts from construction could include the disturbance of the ʻuaʻu habitat at HO, where birds would not be willing to remain in their burrows during the nesting season. Construction noise, vibration, or human proximity could affect the nesting habits of the ʻuaʻu to the extent that they may not return to, remain in, or otherwise utilize the burrows that are inhabited each year. Construction activity at either the Preferred Mees site or Reber Circle site has the potential of causing burrow collapse, directly related to excavation, vibration, or other human activities. Collapse of a burrow could result in ʻuaʻu mortality. Mitigation measures developed to address these potential major, adverse, and long-term impacts are set forth in Table 15, below.

Table 14. Programmatic Monitoring for Active Preservation of Invertebrates, Flora, and Fauna at HO During and After Construction of the ATST Project

Survey Type	Frequency/ Duration	Description
Botanical Reconnaissance	Semi-Annually/ three days	Characterization of types, diversity, stage of development, coverage, and health of endangered ʻahinahina, and non-endangered endemic or AIS plant species at HO and within selected areas of the Park road corridor. Report new occurrences of ʻahinahina to HALE and USFWS. *(NOTE: Monitoring measures/studies would be coordinated/approved by HALE, and any activities conducted along the Park road corridor would be approved pursuant to the SUP process.)*
Invertebrate Collections	Semi-Annually/ one week	Day and night collection of invertebrates during one week in winter and one week during summer months. Identification and taxonomy for both ground and shrub dwellers. Population estimates for developed and undeveloped areas within HO, and selected areas of the Park road corridor. Report collections at HO to State Forestry Division and to NPS for endangered arthropods. Collections transmitted to Bishop Museum or other authorized repository. *(NOTE: Monitoring measures/studies would be coordinated/approved by HALE, and any activities conducted along the Park road corridor would be approved pursuant to the SUP process.)*
Field Faunal Survey	Semi-Annually/ one week	Field observations at HO and selected areas of the Park road corridor for faunal presence, e.g., scat, tracks, eaten plants, etc. *(NOTE: Monitoring measures/studies would be coordinated/approved by HALE and any activities conducted along the Park road corridor would be approved pursuant to the SUP process.)*
Video Avian Monitoring	Throughout Nesting Season	Ongoing monitoring using visible and nighttime infrared techniques to observe endangered ʻuaʻu in and around HO during construction to identify any behavioral changes. Monitoring also includes tracking threats to ʻuaʻu, such as rats, feral domestic animals, goats, and pigs. Report to USFWS, HALE resource management.
Faunal Radar Survey	Upon Project Completion/ 10 days during ʻuaʻu nesting season	Radar observations for endangered ʻuaʻu and ʻopeʻapeʻa flight patterns around the Proposed ATST Project, upon completion of the structure. Characterization of flight paths, altitudes, frequency, to compare with baseline obtained earlier in decade. Assess and document any effects due to proximity of structure near ʻuaʻu burrow colony. Provide report to USFWS upon request.

Table 15. Summary of Mitigation Measures Adopted During Section 7 Consultations

Possible Impact	Avoidance and Minimization Measure Adopted
Collision of petrels with equipment and buildings	Construction crane will be lowered at night and marked with white visibility polytape. All structures will be painted white. No outdoor lighting will be associated with the project.
Burrow collapse from construction vibration	USFWS set ground vibration threshold for burrow collapse. Vibration will be monitored to ensure that the burrow collapse threshold is not reached.
Noise concerns and incubating Hawaiian petrels	Construction noise will not be louder than ambient wind noise at nest during incubation period (April 20th through July 15th). Only two truck round-trips per day will be taken to the construction site during the incubation period.
Predator population increase	Trash will be contained. Rat predation at HO.
Transport of invasive species to Haleakalā	Cargo will be thoroughly inspected for introduced non-native species. All ATST facilities and grounds with 100 feet of the buildings will be thoroughly inspected for introduced species on an annual basis and any introduced species found will be eradicated.
Driver education	All drivers will receive a briefing and a breeding season refresher to further reduce the chance that a vehicle associated with the project would cause injury or mortality to nēnē.

With respect to other native and non-native species, the only one that would experience a minor, adverse, and long-term effect would be arthropods. Development of the ATST facility would diminish a small amount of arthropod habitat, including the presence of native plants, and thereby reduce native arthropod species diversity and abundance at both the proposed ATST sites, but would not likely have a direct impact on the persistence of arthropod species on Haleakalā.

Operational impacts on botanical resources are anticipated to be similar to those that currently exist at HO. Disturbance to the soil from routine maintenance and other construction, additional water sources from discharge pipes and gutters, and protection from the elements by objects such as building foundations and sidewalks, provides opportunity for both native and non-native plants to find refuge in otherwise inhospitable locations. It is assumed that this trend would continue if the proposed ATST Project were to become operational at either the Preferred or Alternative site. Loss of numbers and diversity of native plants have already occurred at HO, as reported in the botanical survey (2005) and, therefore, it is anticipated that botanical resources would experience the same minor, adverse, and long-term impacts from operations of the proposed ATST Project at either the Preferred Mees site or at the Alternative Reber Circle site. No additional threats to endangered species have been identified as a consequence of operation at HO.

The No-Action Alternative would result in a negligible, adverse impact on the monitoring of the Kolekole ʻuaʻu colony and less information would be available on their behavior and population.

In summary, construction impacts could have a major, adverse, long-term impact to ʻuaʻu. Mitigation measures to address impacts to biological resources related to construction and operation of the ATST Project at either the Preferred Mees site or the Alternative Reber Circle site would include more than one approach. Application of MIT- 6 and MIT-9 would reduce these impacts to negligible, adverse, and long-term.

It is noted that, as a result of NSF's informal consultation with the United States Fish and Wildlife Service (USFWS) pursuant to the Endangered Species Act, the ATST Project is not anticipated to result in "take" of either ʻua'u or nēnē. After issuance of the SDEIS, the State of Hawai'i Department of Land and Natural Resources (DLNR) Division of Forestry and Wildlife (DOFAW) took issue with that result, and recommended that NSF consult with the Department pursuant to Hawai'i Revised Statutes (HRS) 195D. NSF did initiate consultation with DOFAW pursuant to HRS 195D and, as an extra measure of caution, has voluntarily decided to initiate formal consultation with USFWS so that if "take" of either ʻua'u or nēnē unexpectedly occurs during construction or operation of the ATST, the ATST Project could proceed without interruption. NSF, DOFAW, and USFWS have all agreed to work together with the goal of completing one consultation that will have the dual purpose of satisfying the requirements of HRS 195D and completing NSF's voluntary formal consultation with USFWS. If "take" is estimated to occur as a result of that consultation, any adverse impacts to the species will continue to be negligible for NEPA purposes because HRS 195D requires that mitigation measures be implemented such that adverse impacts are more than offset.

Visual Resources and View Planes

The impacts to views within HALE and to views from populated areas around Maui as a result of the ATST Project were analyzed for each action alternative. Impacts and their intensities were determined based on the comparison of existing views throughout HALE and Maui with images of views including simulations of the ATST Project. Views were selected from within areas identified in a computer-generated viewshed analysis as areas from which the ATST Project would theoretically be visible, given project dimensions and topography. Impacts for each action alternative are summarized in Table 16, below.

Table 16. Summary of Impacts on Visual Resources and View Planes

ATST Project	Impact	Mitigation	Final Impact
Preferred Mees Site Alternative	**Construction** Moderate, adverse, and short-term; Minor, adverse, and short-term; Negligible, adverse and short-term **Operations** Moderate, adverse, and short-term; Minor, adverse, and short-term; Negligible, adverse and short-term	No Mitigation	**Construction** Moderate, adverse, and short-term; Minor, adverse, and short-term; Negligible, adverse and short-term **Operations** Moderate, adverse, and short-term; Minor, adverse, and short-term; Negligible, adverse and short-term
Reber Circle Site Alternative	**Construction** Moderate, adverse, and short-term; Minor, adverse, and short-term; Negligible, adverse and short-term **Operations** Moderate, adverse, and short-term; Minor, adverse, and short-term	No Mitigation	**Construction** Moderate, adverse, and short-term; Minor, adverse, and short-term; Negligible, adverse and short-term **Operations** Moderate, adverse, and short-term; Minor, adverse, and short-term
No-Action Alternative	Negligible, adverse, and long-term	No Mitigation	Negligible, adverse, and long-term

Impacts from Construction of the ATST at the Preferred Mees Site: From within HALE, the prominence of the proposed new structure in views from within two miles of the ATST Project site would result in moderate, adverse and long-term impacts to visual resources. No mitigation would adequately reduce this impact. The new structure would be visible to the point of co-dominance with other nearby structures. It would intensify the already developed appearance in its immediate surroundings, and would also appear to increase slightly the amount of horizontal space occupied by structures in views from within the Park. The new structure would not substantially alter the existing visual character observable from any vantage point. In views from further away in the Park, impacts to visual resources would be negligible, adverse, and long-term. The ATST Project would be barely detectible, if visible at all, from these locations.

From views outside of the Park, throughout Maui, the ATST Project would result in a minor, adverse and long-term impact to visual resources. No mitigation would adequately reduce this impact. The new structure would be visible atop distant ridgelines from a number of viewing

locations and indistinguishable in views from other locations. Because of the distance of these views, regardless of whether HO is visible at present or not, the ATST Project would not substantially alter the visual quality of the views.

Impacts from Construction of the ATST Project at the Reber Circle Site: From within HALE, the prominence of the proposed new structure in views from within two miles of the ATST Project site would result in moderate, adverse and long-term impacts to visual resources. No mitigation would adequately reduce this impact. The new structure would be visible to the point of co-dominance with other nearby structures. It would intensify the already developed appearance in its immediate surroundings, and would appear more prominent in some views than the Mees site alternative. It would also, however, appear completely within the existing HO development footprint, and would not appear to increase the horizontal space occupied by structures in views toward the site from points within the Park. The structure would not substantially alter the existing visual character observable from any vantage point. In views from further away in the Park, impacts to visual resources would be minor, adverse, and long-term. The proposed ATST Project would be visible, but not dominant, along ridgelines in these views. No mitigation would adequately reduce this impact.

From views outside of the Park, throughout Maui, the ATST Project would result in a minor, adverse and long-term impact to visual resources. No mitigation would adequately reduce this impact. The new structure would be visible atop distant ridgelines from a number of viewing locations and indistinguishable in views from other locations. Because of the distance of these views, regardless of whether the HO is visible at present or not, the proposed ATST Project would not substantially alter the visual quality of the views.

No-Action Alternative: Under the No-Action Alternative, the ATST Project would not be built and, thus, the view plane would remain unchanged.

Visitor Use and Experience

There would be moderate, adverse, and long-term impacts on visitor use and experience from changes in the quality of recreational activities such as sightseeing, hiking, backpacking, photography, and camping associated with changes in the viewshed from construction activities at either the Preferred Mees site or the Alternative Reber Circle site, and from construction-related activities along the Park road corridor. Changes in the viewshed during the operations phase would result in major, adverse, and long-term impacts on the visitor use and experience from locations where the proposed ATST Project would be prominently seen, as described in the FEIS, Section 4.5-Visual Resources and View Planes. This would be true regardless of whether the Preferred Mees site or the Alternative Reber Circle site were selected.

Construction noise, prior to mitigation, would have a major, adverse, and short-term impact on visitor use and experience. These impacts, however, would occur over the short-term and would be mitigated (MIT-6) to intensity levels of negligible, adverse, and long term between April 20th and July 15th; at other times of the year noise impacts would be mitigated to moderate, adverse and short-term.

The small increase in traffic during construction would have a negligible impact on travel time and visitor use and experience. During operations, the increased traffic would be even less and would have a negligible, long-term impact on the visitor use and experience.

Impacts on air quality associated with increased construction vehicle traffic and use would be minor, adverse, and short-term, as described in the FEIS, Section 4.11-Air Quality. These impacts would occur over the short-term, would be mitigated to the greatest possible extent, and the impacts on visitor use and experience would diminish in the long-term.

There would be no additional direct impact to the visitor use experience under the No-Action Alternative. The visual impact of HO could, however, still be considered to be contrary to visitor expectations for the summit area with respect to the natural landscape vistas, and, thus, would have a major adverse and long-term direct impact on the visitor experience.

Water Resources

The ATST Project, whether built at the Mees site or the Reber Circle site, would have minor, adverse, direct, short- and long-term impacts on the surface water and negligible, adverse short- and long-term impacts on groundwater within the ROI. The ATST Project would be designed so that the most onsite stormwater would be captured for reuse in an existing cistern, thus reducing the potential adverse impacts on the infiltration basin. Stormwater that does not reach the cistern would be filtered through on-site ground drains where water would percolate to the natural subsurface environment.

Under the Preferred Mees site alternative, replacement of the cesspool would result in a minor, beneficial, and long-term impact on groundwater. The new wastewater treatment system for the ATST Project would be constructed and treatment to domestic wastewater would occur prior to infiltration into subsurface water. Negligible, adverse, and short-term impacts could result if discharges of untreated wastewater occurred while handling, during operations, or in the event of system failure. Otherwise a minor, beneficial, long-term impact would result from removal of the cesspool under the Preferred Mees site alternative.

Under the Reber Circle site alternative, the new wastewater treatment system for the ATST facility would be constructed and treatment to domestic wastewater would occur prior to infiltration into subsurface water. Negligible, adverse, and short-term impacts could result if discharges of untreated wastewater occurred while handling, during operations, or in the event of system failure. The ATST would not discharge to the existing cesspool, however, it would continue to be used by the existing user, and would result in a minor, adverse, and long-term impact on groundwater.

Under the No-Action Alternative, the current surface water features and drainage would remain unchanged and the cesspool used at the existing MSO facility would continue to be used. Thus, under the No-Action Alternative, minor, adverse, and long-term impacts on groundwater quality would be anticipated. No mitigation would be necessary and no indirect impacts would be anticipated. Temporary, localized, minor impacts would be anticipated during construction and standard BMPs would be implemented to minimize impacts to water resources during construction.

Hazardous Materials and Solid Waste

The construction and operation of the ATST Project at either the Preferred Mees site or the Alternative Reber Circle site would have negligible, adverse, long-term direct impacts on hazardous materials (HAZMAT) and solid waste management. Management plans have been prepared for the ATST Project, containment features have been designed, and on-site training would be required for personnel. There would be no change from the current management of solid waste. Other HO facilities would continue to be responsible for their waste.

There would be no change from the current management of solid waste under the No-Action Alternative. Facilities would continue to be responsible for their waste. Negligible adverse impacts on solid waste management would be experienced. Under the No-Action Alternative, the ATST Project would not be constructed, thereby omitting any short-term use of materials. Existing facilities would continue to use materials for mirror coating and cleaning, lubrications, refrigerants, etc. Therefore, the potential for a release would still exist. Negligible adverse impacts would still be expected as a result of the No-Action Alternative.

Infrastructure and Utilities

The removal of the existing cesspool and implementation of an Individual Wastewater System (IWS) under the ATST Project, if implemented at the Preferred Mees site would result in a minor, beneficial, and long-term direct impact on the wastewater system. The implementation of an IWS at the Reber Circle site would have minor, adverse, and long-term impacts on the wastewater system. No mitigation would be necessary to reduce this impact.

Whether constructed at either the Preferred Mees site or the Reber Circle site, the ATST Project would capture all stormwater on site either in the existing MSO cistern or through French drains to be directly filtered to the substrate. Because the ATST Project would not contribute to the HO drainage system, there would be a negligible, adverse, and long-term impact on the surface water at the site. The runoff from impervious surfaces associated with the ATST Project would not increase substantially due to designed capture of stormwater, although transport to the natural drainage locations may be slightly altered.

The anticipated electrical load that would be required by the ATST Project would have a negligible, adverse, and long-term impact on the Maui Electric Co., Inc. (MECO) service to HO. Additional loads from all anticipated needs would be served by an upgrade that has been specified by MECO and power demands could be met with improved efficiency and a safer reserve capacity, and would, thus, result in a moderate, beneficial, and long-term impact on the electrical system.

Fiber optic lines are available at HO that would be adequate for data connectivity and negligible, adverse, and long-term impacts would be anticipated from the additional requirements of the proposed ATST Project.

Moderate, adverse, and short-term impacts to roadways and traffic would occur during construction of the ATST Project at either the Preferred Mees site or the Alternative Reber Circle site. Traffic along State highways and Haleakalā Crater Road would be affected by heavy equipment, delivery of concrete and materials, service trips, and daily commuting of construction

workers. These impacts would be mitigated by MIT-11 and MIT-12, including specific mitigation measures, such as the ones described above and some recommended by the FHWA HALE Road Report (FEIS, Vol. II, Appendix P). These would be included in the HALE-issued SUP and as such would become SUP conditions for the construction and operation phases of the proposed ATST Project. Carpooling and scheduling of deliveries would further minimize conflicts with other traffic, tours, or other activities. The impact to construction-related traffic would be reduced to minor, adverse, and long-term. The operation of the ATST Project would result in negligible, adverse, and long-term, direct impacts to roadways and traffic.The additional ATST-related traffic would be minimal in comparison to existing normal traffic.

There would be major, adverse, and long-term impacts on the FAA communication systems resulting from project implementation at either the Preferred Mees site or the Reber Circle site. Implementation of MIT-2 is anticipated to reduce this impact to negligible, adverse, and long-term.

Noise

Direct impacts of noise from the construction of the ATST Project at either the Preferred Mees site or the Reber Circle site are anticipated to be major, adverse, and short-term. Construction noise emissions would increase the existing ambient noise levels at the summit but would be temporary and intermittent. Trucks and mobile construction machinery would also raise ambient noise above background levels during the construction period. Implementation of MIT-6 would limit outside and on-site construction activities to begin no earlier than 30 minutes after sunrise and end no later than 30 minutes prior to sunset and to be prohibited between April 20th and July 15th, in coordination with USFWS and NPS mitigation measures; MIT-10 would restrict slow-moving construction traffic from traveling along the Park road corridor during peak recreational use (11 a.m. to 2 p.m. daily), other than between mid-February and mid-November, when wide and heavy loads may only traverse the Park road between 12:00 noon and sunset; and MIT-13 would incorporate reasonable noise-reduction practices and abatement procedures into the construction plan to reduce noise impacts. These mitigation measures, however, would not reduce the level of impact. It is acknowledged that the resulting sound levels could affect Native Hawaiian cultural practitioners and those engaged in recreational activities, even when such levels comply with regulatory requirements.

Because the expected levels from ATST operations would be similar to those already present, a 3 dBA increase is reasonably expected. This would result in a minor, adverse, long-term noise impact. There would be no change to existing conditions under the No-Action Alternative. There would be no construction introducing machinery-related noise intrusion to the area and no operational noise aside from existing sources. There would be negligible, adverse, long-term impacts to noise conditions under the No-Action Alternative.

Air Quality

Site development and construction of the ATST Project at either the Preferred Mees site or the Alternative Reber Circle site would have negligible, adverse, short-term direct impacts to air quality at the HO and along the Park road corridor. No mitigation would be necessary and no indirect impacts are anticipated. Vehicle traffic accessing the facility via the Park road corridor would temporarily increase due to the construction vehicles and crews expected during the

construction period. The additional traffic, however, would not significantly add to the current level of vehicle emissions associated with existing HO operations and visitor traffic.

Excavation and grading would generate some hazardous and nuisance air emissions. Actual adverse impacts on air quality at HO, based on proposed operations and regional meteorological conditions, are, however, expected to be temporary, intermittent, and at levels substantially below both human health and hazardous air pollutant industrial hygiene criteria. To minimize fugitive dust emissions, contractors would be required to comply with applicable State regulations under HAR 11-60.1-33, which require the implementation of "reasonable precautions" for controlling fugitive dust. The contractor would implement strict dust-control measures and BMPs as mandated by the LRDP. These operational practices would limit controllable emissions from site activities that could adversely affect the local air quality. These practices would be established through an ongoing program to control fugitive dust by strictly adhering to the procedures imposed by the LRDP on construction projects at HO.

Operation of the ATST Project at either the Preferred Mees site or the Alternative Reber Circle site would have negligible, adverse, short-term and long-term, direct impacts to air quality at HO and along the Park road corridor. No mitigation would be necessary and no indirect impacts are anticipated. There would be no additional impact on air quality from operations of the proposed ATST Project facility at the Mees site. Operations would not produce any major air emissions, and as a result, the facility would meet applicable Federal and State air quality standards. Consequently, as mandated in the LRDP for facilities with stationary sources exceeding threshold quantities of a regulated substance, an air quality risk management plan would not be required for the ATST Project. The relative increase in vehicle traffic accessing the facility via the Park road corridor would not appreciably change. The additional traffic would not significantly add to the current level of vehicle emissions associated with existing HO operations and visitor traffic.

Ongoing construction and site work, unrelated to the ATST, would continue on HO under the No-Action Alternative, however, these impacts would be negligible.

Socioeconomics and Environmental Justice

The ATST Project, whether located at the Preferred Mees site or the Alternative Reber Circle site, would need approximately 20 people for the first year of commissioning. This number is estimated to increase up to a number between 50 and 55 by the final year of commissioning. Approximately two-thirds of the newly hired personnel would work on site on Maui with the remaining personnel working for the proposed ATST Project remotely from either Maui or the UH Manoa campus on O'ahu. No adverse impacts on population and housing are anticipated from this addition to the work force, e.g., there would not likely be a substantial increase in the demand for housing. There would be a minor, adverse, and short-term impact on housing. The ATST Project would have both short- and long-term beneficial impacts on the local economy and employment.

The ATST Project would have negligible, adverse impacts on the schools within the ROI. Local universities and schools would experience a minor benefit from the research conducted at HO and from internships, post-doctoral fellowships and other student programs. It should be noted,

however, that mitigation measures developed to help reduce impacts to cultural resources, such as the educational initiative at MCC designed to address the intersection between Native Hawaiian culture and science, would have a minor, beneficial, and long-term impact on educational outreach.

The potentially affected area is not a predominantly minority or low-income community, so none of the impacts of construction and operation of the ATST Project would disproportionately affect minority or low-income groups. Thus, with regard to environmental justice, the proposed ATST Project would have negligible adverse impacts for either the Preferred Mees site or the Alternative Reber Circle site.

Under the No-Action Alternative, the ATST Project would not be built and, thus, there would be no impacts to population and housing; employment, economics, and income; education and outreach, environmental justice, or protection of children from environmental health or safety risks.

Public Services and Facilities

With its remote location near the summit of Haleakalā, HO is 22 miles from the nearest public services and facilities. With a travel time of nearly an hour to the closest police or fire stations, the facilities at HO are unable to utilize timely services from these Maui public departments. The nearest schools are in Kula, approximately 25 to 27 miles from HO, as is the nearest healthcare facility. The ATST Project, under both action alternatives, would have negligible, adverse, and long-term impacts on these services. Changes would be so small that it would not be of any measurable or perceptible consequence. There would be a moderate, adverse, and long-term impact on recreational activities as a result of the impact on the viewshed from some vantage points within HALE. In summary, public services and facilities would have a minor, adverse, long-term impact. No mitigation would be implemented. Under the No-Action Alternative, the ATST Project would not be constructed and, thus, there would be no measurable or perceptible consequence to public services and facilities.

Natural Hazards

Natural hazards do pose a risk to HO and may affect the ATST Project and its personnel at any time. The ATST Project, under either action alternative would, however, have negligible, adverse impacts on the safety of the public and adverse impacts on the environment would be negligible such as to cause damage, destruction, or loss of life through incorporation of seismic design factors and compliance with the 2006 International Building Code. All HO contractors and operations staff would be trained on the natural hazards unique to the site in order to minimize potential injuries. No mitigation would be necessary to reduce this impact. Under the No-Action Alternative, there would be no change from existing conditions and, therefore, no impacts.

Cumulative Impacts

In the FEIS, cumulative impacts (i.e., the incremental environmental impacts of the action when added to other past, present, and reasonably foreseeable future actions) of the ATST Project at both the Preferred Mees site and Alternative Reber Circle site were analyzed. Likewise, the cumulative impacts of the No-Action Alternative were analyzed. In November 2005, and again

in February of 2009, agencies known to have facilities and operations within the ROI for the resource-specific affected environments were contacted with a request to provide information on current and planned activities that could occur within the reasonably foreseeable future and, thus, contribute to the cumulative impact when considered together with the impacts of the ATST Project.

Land Use and Existing Activities. The impacts of the ATST Project, if constructed at either the Preferred Mees site or the Alternative Reber Circle site, when added to the combined impacts from past, present, and reasonably foreseeable future actions within the ROI would not result in increased cumulative impacts on land use within HO. The ATST's impacts would be similar to those resulting from existing and planned land uses within the Conservation District, and, thus, at either location within HO, the ATST Project is anticipated to result in only a minor, adverse, and long-term cumulative impact. As discussed in the FEIS, there would be a major, adverse, long-term impact on the FAA RCAG signal, causing interference as a result of the ATST Project due to the size of the proposed structure and its proximity to the FAA antenna tower. Implementation of MIT-2, however, would reduce this impact to negligible, adverse, and long-term, and, thus, not increase the cumulative impact on land use and existing activities. There would be no cumulative impact resulting from the No-Action Alternative as there would be no change to the land use or existing activities.

Cultural, Historic, and Archeological Resources. Under either the Preferred Mees Site or the Alternative Reber Circle site, cumulative impacts to cultural resources would be major, adverse and long-term. Construction of facilities on the summit beginning in 1957 and continuing with the proposed construction of the ATST project would result in a long-term major adverse impact. Cumulative impacts to traditional cultural resources include both physical and spiritual impacts. For Native Hawaiians, an uninterrupted view is often cited as necessary to make an emotional and physical connection to a place of importance. Therefore, because the view is already interrupted by man-made structures in the summit area, the addition of the ATST Project would be incremental in degradation of the spiritual values of the ROI with respect to the view. While there is no way to quantify the cumulative impacts of the incremental addition on spiritual values, in consideration of the past, present, and reasonably foreseeable future actions, the addition of the proposed ATST Project would result in readily detectable, localized impacts, with consequences at the regional level to cultural practitioners within greater Hawai'i. Therefore, the cumulative impacts on cultural resources of the proposed ATST Project, combined with past, present, and reasonably foreseeable future actions are considered major, adverse, and long-term.

Previous activities within the ROI have not adversely affected historic and archeological resources. To prevent future adverse impacts, the LRDP was prepared with detailed procedures and practices to avoid adverse, long-term impacts on archeological sites. Therefore, it is anticipated that negligible, adverse, long-term, direct cumulative effects on the historic and archeological resources at HO and within the Park road corridor would occur from construction of the proposed ATST Project at the Preferred Mees site. The same result is true for cumulative impacts on historic and archeological resources at the Alternative Reber Circle site, however, MIT-8 would be applied to offset impacts to historic resources if the Reber Circle site were selected; without that mitigation measure, the impacts to the Reber Circle historic site would be major, adverse, direct, and long-term.

The No-Action Alternative would not contribute to changes in cultural, historic, or archeological resources within HO or along the Park road corridor that constitute the ROI. The cumulative impacts on traditional cultural resources relevant to the No-Action Alternative would remain major, adverse, long-term, and direct. Because there are minor, adverse, and long-term impacts resulting from past, present, and reasonably foreseeable actions within the ROI for historic and archeological resources, the cumulative effects from the No-Action Alternative would remain at the minor, adverse, and long-term for those resources.

Biological Resources. In combination with past, present and reasonably foreseeable future actions at HO, the impacts of the ATST Project at the Preferred Mees site on endangered, threatened, proposed, and candidate plant species would be negligible, adverse, and long-term. For other native and introduced fauna, the combined impacts of past, present, reasonably foreseeable future actions at both the Preferred Mees and Alternative Reber Circle sites would be negligible, adverse, and long-term. To reduce the risk of transporting non-native species or seeds to the project site, NSF has proposed to implement the LRDP for the prevention of introduction of invasive exotic weed species will be followed during the construction, maintenance, and use of the ATST (MIT-9).

Only minor differences in construction impacts exist between the Preferred Mees site and the Alternative Reber Circle site; therefore, the cumulative impacts for all the resources above would be the same for the construction and operation of the ATST Project at the Reber Circle site, with the exception of the ʻuaʻu. The Reber Circle site is a greater distance from ʻuaʻu burrows in the Kolekole colony and is on previously developed land. The likelihood of adverse impacts on the ʻuaʻu colony would be even less than for the Preferred Mees site, and with the nesting period limitations on heavy construction, along with noise and vibration restrictions during construction, the Reber Circle site would be even less likely to result in adverse impacts on the ʻuaʻu at HO. The potential impacts on ʻuaʻu along the Park road corridor during construction at Reber Circle site would be the same as for the Preferred Mees site, which is minor, adverse, and long-term. Therefore, when combined with the impacts from past, present, and reasonably foreseeable future actions at HO, the impacts on ʻua'u within the ROI for both sites are anticipated to be negligible, adverse, and long-term.

Under the No-Action Alternative, no construction would take place and operations would continue as at present. Therefore, the proposed ATST Project would result in no additional impacts to those described above for past and present activities at HO, which would continue to occur. Under the No-Action Alternative, however, the ʻuaʻu monitoring program would be discontinued, which would result in a minor, adverse, and long-term impact on the ability to assess the health, numbers, and behavioral characteristics of the colony population.

Topography, Geology, and Soils. When the impacts of the ATST Project at either the Preferred Mees site or Alternative Reber Circle site are combined with the impacts of past, present, and reasonably foreseeable future actions in the ROI on topography, geology and soils, the result is minor, adverse, and short-term cumulative impacts.

Under the No-Action Alternative, the ATST Project would not be constructed and, therefore, the topography, geology, and soils would not be further impacted. As a result, the cumulative

impacts of the No-Action Alternative when added to the impacts from past, present, and reasonably known future actions within the ROI would remain major, adverse, and long-term.

Visual Resources and View Plane. When the impacts of the ATST Project at either the Preferred Mees site or the Alternative Reber Circle site on visual resources and the view planes are combined with impacts resulting from past, present, and reasonably foreseeable future actions in the ROI, the impact on those resources would be moderate, adverse, and long-term from the Pu'u Ula'ula Overlook and areas of HALE adjacent to HO. From the upper two miles of Park roadway, the cumulative impacts would be moderate, adverse, and long-term, and from the lower portions of the roadway, the cumulative impacts would be negligible, adverse, and long-term. From populated areas of Maui near sea level or higher elevations, the cumulative visual impacts would be negligible, adverse and long term. Under the No-Action Alternative, there would not be a contribution to impacts on visual resources within HO or the adjoining properties that constitute the ROI.

Visitor Use and Experience. When the ATST Project's impacts on the visitor use and experience – whether constructed at either the Preferred Mees site or the Alternative Reber Circle site – are combined with the impacts from past, present, and reasonably foreseeable future actions in the ROI, the cumulative impacts would be major, adverse and long-term. This is largely due to viewshed and noise impacts resulting from the ATST Project; without the ATST Project, those impacts would be moderate, adverse, and long-term. No mitigation would adequately reduce these cumulative impacts.

There would be no direct cumulative impact to the visitor use and experience under the No-Action Alternative, as the visitor use and experience would not alter from the existing conditions.

Water Resources. The ATST Project and other future proposed actions, including the construction of the SLR 2000, would require land-disturbing activities, which could increase the potential for soil erosion to change infiltration routes and drainage patterns. Compliance with State-administered NPDES regulations and the guidelines of the HO SWMP would minimize the impacts on surface and groundwater resources. Because most on-site stormwater would be captured in the existing MSO cistern, the ATST Project would not contribute to HO stormwater systems. Since no changes to the Park road corridor are proposed, there would be no changes in stormwater runoff patterns, infiltration, or drainage within the remaining portions of the ROI. Under either project action alternative, an Individual Wastewater System would be installed, which would capture and process domestic wastewater prior to infiltration into the ground. The Preferred Mees site alternative would replace the existing cesspool, while the Reber Circle site alternative and the No-Action Alternative would leave the cesspool in place, continuing the current minor, adverse, long-term impact on groundwater resources. When added to the past, present, and reasonably foreseeable future actions, the proposed ATST Project would result in minor, adverse, and long-term cumulative impacts on the water resources under either action alternative.

Under the No-Action Alternative, cumulative impacts would also be minor, adverse, and long-term on surface water and groundwater resources within the ROI.

Hazardous Materials and Solid Waste. There are no future projects that have been identified to occur outside of HO that would have any impact on HAZMAT management or the potential for on-site contamination at HO. The ATST Project would be a Conditionally Exempt Small Quantity Generator of hazardous waste, in that it would not generate more than 100 kilograms (approximately one-half of a 55-gallon drum, 27 gallons, or 220 pounds) of hazardous waste, not more than 1 kilogram (2.2 pounds) of acute hazardous waste in one month, and not more than 1,000 kilograms (approximately five 55-gallon drums, or 275 gallons, or 2,200 pounds) of total accumulated hazardous waste and not more than 1 kilogram (2.2 pounds) of accumulated acute hazardous waste at any time. Because the ATST Project at the Preferred Mees site and each of these proposed facilities would be obligated to comply with the requirements of the LRDP, negligible adverse, long-term cumulative impacts on HAZMAT, solid waste, and site contamination at HO would be expected.

If implemented at the Alternative Reber Circle site, cumulative impacts of existing projects and the proposed projects from HAZMAT and solid waste would be similar to those described for the Preferred Mees site, with the exception of the installation of an aboveground storage tank for storing diesel fuel. The increased use, storage and disposal of HAZMAT and waste and solid waste as a result of the future proposed projects and the ATST Project would result in negligible adverse, long-term cumulative impacts.

For the No-Action Alternative, the proposed ATST Project would not be constructed, thereby not involving any short- or long-term use of HAZMAT. Existing facilities would continue to use such materials for mirror coating and cleaning, lubrications, refrigerants, etc., and, therefore, the potential for a release would still exist. Based on the historical record of HAZMAT and waste handling at HO, which is excellent and does not include any EPA-reportable spills of HAZMAT in the more than 30 years since reporting requirements were imposed, the No-Action Alternative would not alter the currently existing negligible, adverse, and long-term impacts.

Infrastructure and Utilities. With the exception of the removal of the Mees septic system, the cumulative impacts on wastewater, stormwater, electrical systems, communication systems and roadways and traffic from the ATST Project at either site would not incrementally add to the impacts resulting from past, present, and reasonably foreseeable future actions at HO and adjacent neighbors. Constructing the proposed ATST Project at the Reber Circle site would, however, include the installation of a wastewater treatment plant and the cesspool at the MSO would continue to operate, which would result in a cumulatively minor, adverse, and long-term impact on wastewater.

Under the No-Action Alternative, the proposed ATST Project would not be constructed, and, therefore, the cumulative impacts on infrastructure and utilities in the ROI from past, present, and future proposed projects combined with impacts from the No-Action Alternative would be negligible, adverse, and long-term.

Wastewater. Construction of the ATST Project at the Preferred Mees site would result in the removal of the existing cesspool at the MSO facility and the installation of an advanced aerobic system to treat sanitary wastewater. Therefore, construction of the ATST Project would likely result in a beneficial change in effluent quality that, along with present and past actions at HO

and adjacent neighbors, would constitute a minor, beneficial, and long-term impact on wastewater generation. The cesspool would remain in place if the ATST Project were built at the Reber Circle site, thus resulting in no incremental cumulative impacts. Under the No-Action Alternative, no incremental cumulative impacts would result.

Stormwater and Drainage. The ATST Project facility would be designed so that most of the on-site stormwater would be captured for reuse in the existing MSO cistern reducing the potential adverse impacts on the infiltration basin. Stormwater that does not reach the cistern would be filtered through onsite French drains where water would percolate to the natural subsurface environment. Therefore, because the ATST Project would not contribute to the overall cumulative impact, the cumulative impact, regardless of the minor, adverse, and long-term impacts on stormwater and drainage patterns from past, present and reasonably foreseeable future actions within Kolekole, would remain negligible, adverse, and long-term under both action alternatives and the No-Action Alternative.

Electrical Systems. The ATST Project at either site would result in a MECO upgrade that would alter the existing electrical system by improving efficiency and providing a safer reserve capacity. In combination with past, present, and reasonably foreseeable future actions, this would result in cumulatively minor, beneficial, and long-term impacts on the electrical system at HO. MECO's plan to upgrade the substation at HO would also lead to cumulatively minor, beneficial, and long-term impacts on the electrical system under the No-Action Alternative.

Communications Systems. The cumulative impact of the ATST Project at either site on communication systems within the ROI would be minor, adverse, and long-term. For telecommunications, there would be negligible cumulative impacts serving the site. The cumulative impacts on the FAA RCAG facility from all actions could be major, adverse, and long-term due to the potential for signal attenuation from the RCAG antenna resulting from the ATST facility. To avoid such a degradation of signal, FAA would implement MIT-2, which would replace the existing RCAG antenna with a high-gain antenna in the same location. The resultant impact would be negligible, adverse, and long-term. Overall, in combination with past, present and reasonably foreseeable future actions at HO and adjacent neighbors, the cumulative impacts of the proposed ATST Project on communications would be negligible, adverse, and long-term. Under the No-Action Alternative, no incremental impacts would result.

Roadways and Traffic. Combining the impacts on roadways and traffic from past, present, and anticipated future activities with those anticipated from the ATST Project, there is a potential for moderate, adverse, and short-term cumulative impacts in HO during construction of the ATST Project at either site. The cumulative impacts from traffic on the HALE roadway are anticipated to be moderate, adverse, and long-term as well. Mitigation measures, MIT-12 and MIT-13, would reduce the adverse impacts to minor, adverse, and long-term within HALE. A source of cumulative impacts to roadways and traffic would be the collateral damage to roadways caused by heavy vehicle traffic during construction of the ATST Project and interference with visitor traffic during peak travel times to HALE and the summit of Haleakalā. The use of the Park road by these vehicles in combination with past and present actions at HO and adjacent neighbors would have a cumulative minor, adverse, and long-term impact on the longevity of the

pavement. The No-Action Alternative would not incrementally add to the impacts resulting from past, present, and reasonably anticipated activities.

Noise. Construction of the ATST Project at either site would result in high noise levels during certain times of the year and during certain hours, as described in Section 4.10 of the FEIS. Therefore, when added to noise impacts from past, present, and reasonably foreseeable activities, the cumulative noise impacts on persons within 2,500 feet of the ATST Project site from construction at either the Preferred Mees site or Alternative Reber Circle site would likely be major, adverse, and long-term. Mitigation measures restricting construction noise would be implemented to limit outside and on-site construction activities to begin no earlier than 30 minutes after sunrise and end no later than 30 minutes before sunset, and further limited between April 20th and July 15th, in coordination with USFWS and NPS mitigation measures, reducing the impacts to negligible, adverse, long-term impacts during those periods.

The cumulative noise impacts from past, present, and reasonably foreseeable future actions when added to those from the No-Action Alternative are anticipated to remain at minor, adverse, and short-term. Under the No-Action Alternative, the ATST Project would not be constructed and, therefore, noise conditions would not change.

Air Quality. The cumulative impacts on air quality within the ROI from past, present, and reasonably foreseeable future actions, including those from the ATST Project at either site, would essentially be considered negligible, adverse, and long-term.

The cumulative air quality impacts from past, existing, and reasonably foreseeable future actions when added to those from the No-Action Alternative are anticipated to be negligible, adverse, and short-term.

Socioeconomics and Environmental Justice. The socioeconomic impacts associated with past, present, and reasonably foreseeable projects combined with those anticipated from the ATST Project would be minor, adverse, and long-term. For employment, economics and income, the cumulative impacts would be minor, beneficial, and long-term. Specifically:

1. the cumulative impacts on housing would be minor, adverse and long-term;
2. the cumulative impacts on economics and income would be minor, beneficial and long-term; and
3. the cumulative impacts on education and outreach would be minor, beneficial, and long-term.

The cumulative impacts on environmental justice would be negligible, adverse, and long-term, and the cumulative impacts on the protection of children from environmental health or safety risks would be negligible, adverse and long-term.

Public Services and Facilities. Under all three alternatives, the cumulative impacts on public services and facilities are anticipated to be negligible, adverse, and long-term. There would be no measurable or perceptible consequence as a result of the No-Action Alternative. The only exception to this is for impacts on recreational facilities. While the ATST Project would not

limit the recreational facilities and resources at HALE, the visual and noise impacts would add an incremental adverse impact on recreational facilities. The main attractions for recreation are the vistas, and the most visited locations include the Pu'u Ula'ula Overlook, the Haleakalā Visitor Center, the Leleiwi Overlook, the Park Headquarters Visitor Center, and the crater trails. During construction, the cumulative impacts on recreational facilities would be major, adverse, and long-term for high impact noise out to a distance of about 2,500 feet from the ATST Project area. Mitigation measures would reduce the impacts part of the time. (*See* FEIS Section 4.10 for a discussion of noise impacts.) During operations of the ATST Project, the cumulative impact from past, present, foreseeable future activities and the proposed ATST Project on recreational resources for the Park road corridor would be minor, adverse, and long-term. From several vantage points, the viewshed would result in incremental adverse impacts; depending upon the particular vantage point, the cumulative impacts would either be minor or moderate, adverse, and long-term. In particular, if the ATST were built at the Reber Circle site, it would appear taller, closer, and more imposing because it would dominate part of the viewshed from the Pu'u Ula'ula Overlook and, thus, result in moderate, adverse, and long-term cumulative impacts on that HALE recreational facility.

Natural Hazards. Implementing the ATST Project would not increase the potential for natural hazards and would not change the nature of natural hazards that occur within the ROI. Therefore, the cumulative impacts from past, present, and reasonably foreseeable projects when added to those from the ATST project at either the Preferred Mees site or the Alternative Reber Circle site would be negligible, adverse, and long-term. There would be no incremental addition to cumulative impacts from the No-Action Alternative.

Mitigation Measures

NSF acknowledges that construction of the ATST would result in several major adverse environmental consequences. Therefore, a significant part of the NEPA process was dedicated to finding ways in which those adverse impacts could be mitigated. By far, the most significant adverse impacts from construction of the ATST would be to cultural resources and certain viewsheds. Noise impacts would also be major, albeit short-term. If mitigation were possible, NSF made every reasonable effort to pursue it. Many times, NSF was successful in working with sister agencies and interested members of the public to find ways in which adverse impacts could be mitigated; other times, such mitigation was not possible. For example, while the height and color of the ATST would contribute to adverse visual impacts, no mitigation of those impacts is possible. Reduction of the height of the tower would severely compromise the functionality of the telescope due to the need for the telescope to rise above turbulent air. The white paint color likewise could not be mitigated because the reflective white color is essential to mitigate solar heating of the telescope enclosure. Noise impacts could, in part, be successfully mitigated.

Perhaps the most significant resources adversely impacted would be the cultural resources. The summit of Haleakalā is a Traditional Cultural Property (TCP) and has significant cultural and spiritual meaning to the Kanaka Maoli (Native Hawaiian). As discussed more fully below in the section concerning NSF's Section 106 consultation process pursuant to the NHPA, NSF made repeated and significant efforts to find ways to mitigate adverse effects to cultural resources. While NSF acknowledges that the impact of the project on the spiritual importance of the

summit to Native Hawaiian practioners cannot be mitigated, the PA represents NSF's efforts to use all practicable means to reduce the impacts as best as possible. NSF did agree to mitigation designed to accommodate the practices of traditional practitioners, minimize the potential harm to cultural resources through implementation of Best Management Practices and "Sense of Place" training in accordance with the LRDP, and agreeing to decommission and deconstruct the ATST within fifty (50) years from the date operations commence, unless, after consultation with Native Hawaiian Organizations (NHO), NSF decides otherwise.

A significant way in which NSF has used all practical means to mitigate, avoid, and minimize harm to cultural resources is to form the ATST Native Hawaiian Working Group (ATST NHWG). The concept to create the ATST NHWG, whose purpose is to continue to consult with NSF and the ATST Project team on certain aspects of the ATST Project, resulted from the Section 106 consultation process. The ATST NHWG has been formalized in the Programmatic Agreement (PA) that concluded NSF's Section 106 consultation process (*see* Attachment A).

NSF has also agreed to try to foster a better understanding between Native Hawaiian culture and science and, to that end, has decided to support MCC in developing an educational initiative (Akeakamai I Kā La Hiki Ola, or Scientific Exploration Beneath the Life-Bringing Sun) on Maui to address the intersection between traditional Native Hawaiian culture and science. To support this educational initiative at MCC, NSF will make available $20 million ($2 million per fiscal year, commencing in FY 2011), subject to applicable Federal law.

Table 17 below sets forth a summary of the full suite of mitigation measures that would accompany the ATST Project under either the Preferred Mees Alternative or Reber Circle Alternative.

Table 17. Summary of Mitigation Measures

Construction Activities
Specific stipulations with regard to this [the HALE] entrance station work have been formulated by HALE staff and further elaborated by the ATST engineering team: 1. The ATST Project would assure that the septic system is adequately protected. Metal plate covers, grade beam structures or similar protective devices would be deployed. If protection proves impractical, relocation of the septic tank could be considered as an option. 2. The ATST Project would protect the existing utility man-hole covers, including the following measures: a) avoid direct axle loading on the covers, b) replace the existing covers with heavier gage steel; or, c) reinforce the existing covers with additional steel bracing. 3. The ATST Project would ensure that the improved shoulder would be adequate for the heavy loads anticipated by ATST engineers. 4. Periodic maintenance of the widened shoulder area, such as recompaction, regrading, etc. as necessitated by settling, erosion, or washout, would be the responsibility of the ATST Project.

5. A barricade system, such as a gate, removable bollards or similar devices, would be installed by the ATST Project on the widened shoulder to deter Park visitors and staff from driving on it.

6. This area contains native plants and is nēnē (Hawaiian Goose) habitat. Widening of the shoulder would be completed outside the nēnē nesting season, which is November through March. Native plants would be protected when possible – HALE staff would work with the ATST Project team on this.

7. When the widened shoulder is no longer needed for the proposed ATST Project, it would be required to be fully restored and rehabilitated. The ATST Project would consult with HALE staff and would review and approve the final restoration/rehabilitation plan.

Best Management Practices

A variety of BMPs (required practices established in the UH IfA LRDP and policies reflecting public consultation during the EIS process) would be implemented during construction in order to prevent damage to the natural and cultural environment. These BMPs include the following:

1. Implementation of the Stormwater Management Plan (SWMP), specific to HO, which is included as Appendix L to the FEIS. This would include all BMPs in Sections 3.1 and 3.2 of Appendix L for recommended construction practices and stormwater control.

2. During construction temporary diverters and hard surfaces would be utilized to direct surface water flow to the existing stormwater drainage system. As soon as possible, permanent gutters and leaders would be installed on the buildings to capture rainwater and direct it to the underground cistern.

3. Portable toilets with containment tanks would be utilized during early construction work. As soon as possible, a permanent wastewater treatment facility would be installed, which uses aeration and biologically accelerated treatment techniques that achieve effluent standards acceptable for infiltration back to groundwater.

4. Cultural resources monitoring during all leveling and excavation activities in order to prevent damage to undiscovered cultural resources.

5. Using native soils to fill holes upon completion of construction, and replanting grounding trenches, other excavated areas, and soil deposition areas with native vegetation to prevent erosion.

6. Scheduling deliveries of concrete and other materials at times that minimize conflict with tourist traffic on the Park road to Haleakalā.

7. Using signage at the project site and along the roadways to ensure vehicle, pedestrian, and bicycle safety during construction.

8. Dust control would be done by watering the disturbed ground using non-potable water trucked to the site by the contractor specifically for that purpose. Potable water would not be used for dust control.

IfA LRDP website: http://www.ifa.hawaii.edu/haleakala/LRDP/

FEIS Mitigation Measures This Table summarizes the mitigation measures designed to reduce, minimize, or avoid impacts to resources that may be adversely affected by the ATST Project.		
Mitigation No.	**Mitigation Description**	**Affected Resources (FEIS Vol. I)**
MIT-1	NSF would decommission and deconstruct the proposed ATST Project at the end of its productive lifetime (approximately 50 years from the date operations commence), unless decided otherwise in consultation with the Native Hawaiian community. In that case, NSF would take steps to divest itself of all responsibility of the ATST Project.	Section 4.1-Land Use and Existing Activities* Section 4.2-Cultural, Historic, and Archeological Resources *mitigation not required, but applied to reduce long- term impacts
MIT-2	FAA will erect high-gain antennas in the same location as the current RCAG antennas and modifying/replacing the existing platforms on which the antennas are mounted, to accommodate wind loading and configuration of the new antennas. The FAA has stated that further modification of the site and relocations of the antennas may be needed, but environmental impacts from such a potential modification and relocation would not rise to a level of significance.	Section 4.1-Land Use and Existing Activities Section 4.9-Infrastructure and Utilities
MIT-3	NSF, AURA/NSO, and UH IfA, in consultation with the Native Hawaiian community, will use best efforts to locate an area for a Hawai'i star compass at the summit.	Section 4.2-Cultural, Historic, and Archeological Resources
MIT-4	In accordance with IfA's Long Range Development Plan, all construction crewmembers would attend UH-approved "Sense of Place" training prior to working on the proposed ATST Project.	Section 4.2-Cultural, Historic, and Archeological Resources
MIT-5	AURA/NSO would hire a cultural resource monitor to ensure protection of existing traditional cultural resources during construction. The cultural resource monitor will be a Kanaka Maoli, preferably a kupuna (elder) and if possible a kahu (clergyman) as well, and one who has knowledge of the spiritual and cultural significance and protocol of Haleakalā. The cultural resource monitor's knowledge should be concentrated in traditional and cultural practices and protocols. The cultural resources monitor would be chosen in consultation with appropriate organizations and individuals with knowledge of such traditions and protocols.	Section 4.2-Cultural, Historic, and Archeological Resources

Mitigation No.	Mitigation Description	Affected Resources (FEIS Vol. I)
MIT-6	HALE would restrict noise levels during certain hours of the day and during certain months of the year, limit on-site and outside ATST-related construction activities during the time-frame from 30 minutes after sunrise to 30 minutes prior to sunset, limit the hours for wide load vehicles to traverse the Park road (such vehicles need to come through the Park during the night between approximately 8:00 p.m. and 4:00 a.m. between mid-November and mid-February, and from noon to sunset between mid-February and mid-November, however, wide and heavy loads are prohibited from coming through the Park at night between April 20th and July 15th). The seasonal restriction on wide load traffic is also imposed by USFWS.	Section 4.2-Cultural, Historic, and Archeological Resources; Section 4.3-Biological Resources; Section 4.6-Visitor Use and Experience; Section 4.10-Noise
MIT-7	SUP Pre- and Post-Project Documentation: Prior to and after the proposed ATST Project, all historic features and other areas susceptible to potential impact along the Park road shall be photographed and documented (see FHWA report – "Haleakala Highway, Haleakala National Park, Pavement Drainage Condition Investigation, Distress Identification and Recommendations Report # HALA 3-2-2009, March 2, 2009 (revised April 2009)", found in FEIS Vol. II-Appendix P). This will be completed by a qualified person funded by the ATST Project.	Section 4.2-Cultural, Historic, and Archeological Resources
MIT-8	Remove site Archeological Site 50-50-11-5443, concrete ring, which is a remnant of a 1952 radio telescope experiment, in accordance with the Archaeological Data Recovery Plan.	Section 4.2-Cultural, Historic, and Archeological Resources
MIT-9	Mitigation measures developed in coordination with NPS and USFWS would implement monitoring, avoidance, and minimization measures for the project, including the following: 1. The Project will fund an agreed-upon and qualified person to conduct reasonable biological monitoring activities as outlined by the USFWS in its informal consultation. Specifically, the monitor will ensure that any changes in behavior and any petrel mortality associated with the proposed ATST Project are monitored and reported to the NPS and USFWS. The monitor will also monitor the impacts to nēnē and other biological resources. All monitoring activities shall take place during the construction phase of the proposed ATST Project and subsequently during the first three years of the operations phase.	Section 4.3-Biological Resources

<table>
<tr><th>Mitigation No.</th><th>Mitigation Description</th><th>Affected Resources (FEIS Vol. I)</th></tr>
<tr><td>MIT-9 (cont.)</td><td>
2. The National Park Service, in cooperation with the State Division of Forestry and Wildlife (DOFAW), will likely continue to monitor and manage the ‘ua‘u, as it has for over 25 years. This monitoring has included annual surveys of the Kolekole colony for new burrows, and NPS maps of active burrow locations at the Kolekole colony have been provided to IfA periodically for a number of years. Independently, a biological monitor provided by the proposed ATST Project would work with NPS resource staff to survey the colony routinely for new burrows. Should newly active burrows be found closer to ATST than those shown in Figure 3-7 of the FEIS (40-feet), additional Section 7 consultation with USFWS would be necessary.

3. Prior to the possibility of “take,” NSF has voluntarily agreed to pursue formal Section 7 consultation with USFWS that is to be done in coordination with the State’s HRS Section 195D process.

4. Endangered Species Act Compliance - The construction must adhere to the mitigation measures outlined in the informal Section 7 consultation with the USFWS. The USFWS consultation addressed (a) noise and vibration impacts, (b) ground vibration that could collapse petrel burrows, (c) flight obstacles, (d) spread of AIS from construction vehicles, and (e) increased traffic and potential collisions with wildlife. As requested by DLNR, AURA/NSO would monitor cumulative noise and vibration during construction to ensure that noise and vibration thresholds are not exceeded at the site, in accordance with the USFWS Section 7 Informal Consultation Document (FEIS Appendix M and supplemental e-mail concurrence by USFWS dated November 20, 2009). Noise and vibration measuring equipment would be monitored to ensure that endangered species are not exposed to potential harm.

A summary of the Section 7 informal consultation is included below:
<table>
<tr><th>Possible Impact</th><th>Avoidance and Minimization Measure Adopted</th></tr>
<tr><td>Collision of petrels with equipment and buildings</td><td>Construction crane will be lowered at night and marked with white polytape for visibility. All structures will be painted white. No outdoor lighting will be associated with the project.</td></tr>
</table>
</td><td></td></tr>
</table>

Mitigation No.	Mitigation Description		Affected Resources (FEIS Vol. I)
MIT-9 (cont.)	**Possible Impact**	**Avoidance and Minimization Measure Adopted**	
	Burrow collapse from construction vibration	USFWS set ground vibration thresholds for burrow collapse. Vibration will be monitored to ensure that the burrow collapse threshold is not exceeded.	
	Noise concerns and incubating Hawaiian petrels	Construction noise at burrows within 80 meters will be no louder than 83 dBA measured at 5-feet from the source during incubation periods (April 20th through July 15th). Only two truck round-trips per day will be driven to the construction site during the incubation period.	
	Predator population increase	Trash will be contained. Rat predation at the Haleakalā Observatories Hawaiian petrel.	
	Transport of invasive species to Haleakala	Cargo will be thoroughly inspected for introduced non-native species. All ATST facilities and grounds with 100 feet of the buildings will be thoroughly inspected for introduced species on a semi-annual basis and any introduced floral species found will be removed.	
	Driver education	All drivers will receive a briefing and a breeding season refresher to further reduce the chance that a vehicle associated with the project would cause injury or mortality to nēnē.	
	5. Alien Invasive Species Prevention - NPS vehicle, equipment, and materials washing and inspection protocol will be followed by the ATST Project. Further, to augment prevention, the IfA has implemented weeding throughout HO. This would reduce or eliminate AIS introduction if prevention is not successful.		

Mitigation No.	Mitigation Description		Affected Resources (FEIS Vol. I)
MIT-9 (cont.)	**Possible Impact**	**Avoidance and Minimization Measure Adopted**	
		6. Impact Prevention To Nēnē At Entrance Station - To enable wide loads to clear the Park entrance station, an area 12-feet wide, currently occupied by a septic tank, underground utilities, and native vegetation, would be temporarily developed into a drivable surface. To mitigate the potential impact on nēnē that frequent the area, widening of the shoulder would be completed outside the nēnē nesting season. Park staff would work with the ATST project team to implement nēnē avoidance methods for this road-widening work. Avoidance measures would include survey of the site for nēnē prior to construction and installation of temporary "orange fencing" around the outer perimeter of the construction area to prevent nēnē from walking into the site during construction. The site will be restored with native vegetation after use to further reduce impacts on nēnē. 7. Programmatic Monitoring - A programmatic monitoring plan for invertebrates, flora and fauna during the project has been prepared for the project, as described in [FEIS] Table 4-1.	
MIT-10	Slow moving vehicles and/or vehicles that are class 5 or larger should not travel through the Park between approximately 11:00 a.m. and 2:00 p.m. These are peak visitation hours. The ATST Project shall provide regular updates to appropriate NPS staff during the project so NPS staff can provide information to Park visitors.		Section 4.6-Visitor Use and Experience; Section 4.10-Noise
MIT-11	Contractors would be made aware of the potential for road damage and would be required to take measures to minimize the damage. Any damage to HO roadways that does result from ATST construction traffic would be repaired so as to, at a minimum, restore those roadways back its condition before construction of the proposed ATST Project. These mitigation measures, to be negotiated between the affected parties, would reduce the overall impact on HO roadways and traffic down to minor, adverse, and short-term impacts.		Section 4.9-Infrastructure and Utilities

Mitigation No.	Mitigation Description	Affected Resources (FEIS Vol. I)
MIT-12	All construction-related traffic within the Park road corridor would be coordinated with HALE and conducted in compliance with an SUP issued by HALE, so as to avoid or minimize: damage to the road pavement, potential damage to historic structures along the park road corridor, traffic congestion, and other potential adverse impacts on Park resources and the visitor use and experience. SUP provisions issued by HALE would include mitigation measures to address traffic issues, potentially including those recommended in the FHWA HALE Road Report. The total number of wide loads will not exceed 25, including no more than 2 loads up to 10 meters (32 feet 10 inches) and no more than 23 loads up to 7 meters (23 feet 0 inches) over the course of the ATST Project. The ATST Project will ensure that these wide loads will not exceed clearances along the Park road. Every effort will be made to avoid driving wide loads on the edges of the Park road. The provision of wide-load truck access at the HALE entrance station would require special mitigations related to that project, as described in FEIS Section 2.4.3-Construction Activities, Construction Traffic. This would include: 1. Assurance by the ATST Project that the septic system is adequately protected. Mitigation may include placement of metal plate covers, grade beams, other protective structures, or relocation of utilities as a last resort. 2. Protection of existing utility man-hole covers. Specifically, the Project would: a. avoid direct axle loading on the covers, b. replace the existing covers with heavier gage steel; or, c. reinforce the existing covers with additional steel bracing. 3. Provision of a barricade system, such as a gate, removable bollards or similar devices on the widened shoulder to deter Park visitors and staff from driving on it. 4. To minimize the potential impact to the nēnē habitat in this area, the access widening project would be completed outside the nēnē nesting season, which is November through March. 5. Native plants in the area of the access widening project would be protected when possible and HALE staff would work with the Project on this mitigation. 6. When the widened access is no longer needed for the proposed ATST Project, the area would be fully restored and rehabilitated to its pre-existing condition.	Section 4.9-Infrastructure and Utilities

Mitigation No.	Mitigation Description	Affected Resources (FEIS Vol. I)
MIT-13	To mitigate construction noise, contractors would implement reasonable noise-reduction practices and abatement procedures. These would include the following source control mitigation measures, all regarded as somewhat standard in the industry. These mitigation measures to minimize expected noise impacts during construction at HO would be as follows: 1. Conduct all noise-emitting activities within strict day and time constraints, with work prohibited during sensitive nighttime periods. 2. Reduce or substitute power operations/processes through use of proportionally sized and powered equipment necessary only for tasks at hand. 3. Maintain all powered mechanical equipment and machinery in good operating condition with proper intake and exhaust mufflers, 4. Turn off or shut down equipment and machinery between active operations; and, 5. Shield noise sources where possible. Contractors would be required to comply with applicable State noise regulations, under HAR 11-46.	Section 4.10-Noise
MIT-14	During the 50-year lifetime of ATST, the Project will periodically reassess technological options for new types of coatings, more efficient cooling methods, or improved compensation for thermal turbulence which may allow the ATST enclosure and buildings to be painted a color other than white. If such future technology is determined to be an effective, reliable and affordable solution that meets the scientific requirements of the ATST Project, NSF will consider repainting the exterior structures of the ATST with a more neutral color.	Section 4.2-Cultural, Historic, and Archeological Resources
MIT-15	If there are Native Hawaiian scientists among the pool of scientists qualified to conduct research at the proposed ATST Project, NSO will reserve up to 2% of total ATST usage time for these Native Hawaiian scientists. Usage time will be provided through the Telescope Allocation Committee process similar to other scientists' requests based on technical feasibility and scientific merit. Unused time will not be carried forward to the next allocation period. Qualifications for usage will be based on established NSO guidelines.	Section 4.2-Cultural, Historic, and Archeological Resources

Mitigation No.	Mitigation Description	Affected Resources (FEIS Vol. I)
MIT-16	The exterior design for the lower portion of the ATST building will include a well thought-out representation of traditional Hawaiian culture suitable to the Haleakalā setting, such as artwork by Native Hawaiian artists that depict Maui and the Sun or other appropriate motifs. These depictions will be developed in consultation with the ATST NHWG.	Section 4.2-Cultural, Historic, and Archeological Resources
MIT-17	NSF will support Maui Community College (MCC) in developing an educational initiative (Akeakamai I Ka La Hiki Ola, or Scientific Exploration Beneath the Life-Bringing Sun) on Maui to address the intersection between traditional Native Hawaiian culture and science. To support this educational initiative at MCC, NSF will make available $20 million ($2 million per fiscal year, commencing in FY 2011), subject to applicable Federal law.	Section 4.2-Cultural, Historic, and Archeological Resources
MIT-18	UH IfA will work with appropriate authorities to consider renaming the roads on the summit.	Section 4.2-Cultural, Historic, and Archeological Resources

Additional Mitigation Measures

Section 106 Programmatic Agreement

As a result of NSF's Section 106 consultation process pursuant to the NHPA, a PA was reached. All of the terms set forth therein shall also be made part of the mitigation measures associated with the ATST Project. The fully executed PA is attached hereto as "Attachment A."

HALE Special Use Permit

Since August of 2008, NSF has been working with the ATST Project team and the NPS on a proposed SUP to allow ATST-related commercial vehicles to traverse along the Park road during the construction and operations phases of the ATST Project. Several key provisions have already been negotiated and are part of the mitigation measures committed to by NSF in this Table. Additional provisions will be negotiated and the SUP finalized prior to construction.

Federal Aviation Administration Mitigation

NSF and the FAA have been working together to address any potential issue involving a degradation of signal as a result of the proposed ATST Project. The FAA informed NSF that, "[t]he signal interference can be mitigated by replacing the existing antennas with high gain antennas and replacing/modifying the existing antenna towers to provide increased tower platform size to accommodate the new antennas. Further modifications to the site and relocation of the antennas may be needed to restore signal propagation to pre-construction values." The FAA further informed NSF that any further modifications to the site and relocation of the antennas are not anticipated to result in significant effects to the environment. The FAA and NSF are currently working out the details of implementing this mitigation.

Environmentally Preferable Alternative

The No-Action Alternative would result in the least harm to the environment as the ATST would not be built. If, however, the No-Action Alternative were selected, the purpose and need of the ATST Project would not be met. The two action alternatives – the Preferred Mees Alternative and the Reber Circle Alternative – both, however, do meet the purpose and need of the ATST.

Both action alternatives were found to meet the science objectives for the ATST Project and both are located at sites within HO on the island of Maui. The environmental impacts of each alternative are similar with relatively minor exceptions. Both share the same major, adverse, and long-term impacts on cultural resources, and both would result in major, adverse, and short-term noise impacts. The two alternatives do, however, differ in one very important respect. While both also would result in moderate, adverse, and long-term impacts to the viewshed from various vantage points, the ATST, if constructed at the Reber Circle site, would stand on ground that is approximately 20 feet higher in elevation and would be closer to the down slope of the mountain, thus resulting in even more significant adverse impacts to certain viewsheds.

Throughout the NEPA process, the public voiced its strong concern about the height of the ATST. For example, for HALE visitors, the main attractions for recreation are the vistas, and the most visited locations include the Pu'u Ula'ula Overlook, the Haleakalā Visitor Center, the Leleiwi Overlook, the Park Headquarters Visitor Center, and the crater trails. If the ATST were built at the Reber Circle site, it would appear taller, closer, and more imposing because it would dominate part of the viewshed from the Pu'u Ula'ula Overlook. Therefore, although the environmental impacts for both action alternatives are very similar, the ATST would not appear as tall and prominent within certain important viewsheds if the Preferred Mees Alternative were selected. Accordingly, as between the two action alternatives, the Preferred Mees Alternative is the more environmentally preferable one.

C. SECTION 106 COMPLIANCE

As stated in 36 CFR Part 800, *"Section 106 of the National Historic Preservation Act requires Federal agencies to take into account the impacts of their undertakings on historic properties and afford the Advisory Council on Historic Preservation (ACHP) a reasonable opportunity to comment on such undertakings."*

In compliance with Section 106, NSF invited participation in this process to Native Hawaiian Organizations and individuals who may attach religious, spiritual, and cultural significance to the summit of Haleakalā, a Traditional Cultural Property. At the time the DEIS was published, NSF continued its outreach efforts to identify Native Hawaiian Organizations that might have an interest in the Section 106 consultation process. To that end, assistance was requested from the Office of Hawaiian Affairs (OHA) and the Native Hawaiian community prior to each consultation meeting to identify Native Hawaiian Organizations to invite.

In September of 2007, the U.S. Department of the Interior's Office of Hawaiian Relations published in the Federal Register, Vol. 72, No. 186, a Notice regarding the development criteria for establishment of a Native Hawaiian Organization (NHO) Notification List. The intent of the NHO list is to make available to other Federal agency officials this mechanism to assist with reasonable and good faith efforts to identify NHOs that are to be notified or consulted with when required by statute or when desired. Although the NHO list was not published prior to the publication of the DEIS, NSF did review the NHO list prior to conducting its August 2008 consultation meetings and invited all organizations appearing on the NHO list that had not previously been identified

Section 106 Consultation Chronology

The ACHP was sent a formal notification letter in June 2005 announcing the intent of NSF to prepare an EIS for the proposed ATST Project. This pre-assessment letter included a project description with the intent to prepare an EIS, detailed information about the three Public Scoping Meetings, and ATST Project management contact information. On July 6, 2006, a letter was sent to the ACHP, pursuant to 36 CFR § 800.6(a)(1)(iii), informing the ACHP of NSF's finding of adverse impact regarding the proposed undertaking (the ATST Project). The letter also included a list of organizations and individuals the NSF has been in consultation with throughout the Section 106 process, a copy of CKM Cultural Resources' evaluation for the proposed Project, and a copy of a letter that was sent to Melissa Kirkendall, Maui archeologist, State Historic Preservation Division (SHPD), requesting concurrence of the agency's adverse impact finding (ACHP, 2006). Additional information pursuant to Section 800.11(e) of the ACHP regulations was submitted to the Council for their review and determination of whether their participation in this matter is warranted. Ultimately, the ACHP decided to become a consulting party to NSF's Section 106 process.

The SHPD is the responsible State of Hawai'i entity with which NSF is required, pursuant to the NHPA, to engage in Section 106 consultations regarding the proposed ATST Project. A letter dated June 20, 2005 was sent to the SHPD (Melanie Chinen, former Administrator; Melissa Kirkendall, former Maui Archeologist; and Cathleen Dagher, former Assistant Maui Archeologist) to notify them of NSF's intent to prepare an EIS. NSF directly, and through the environmental consultant KC Environmental, Inc. (KCE), corresponded with the SHPD regarding formal and informal consultation meetings. Since the publication of the DEIS, NSF and the SHPD have engaged in consultations regarding NSF's Section 106 process and ways in which adverse impacts need to be addressed. In September 2005, on behalf of the NSF, KCE initiated consultation in accordance with Section 106 of the NHPA through numerous communications between Melissa Kirkendall, former Maui SHPD Archeologist and Archeologist Erik Fredericksen of Xamanek Researches, LLC.

On January 24, 2006, informal consultation was initiated with Kahu Charles K. Maxwell, Sr. and Dane Maxwell of CKM Cultural Resources and Kumu Hula Hokulani Holt-Padilla of the Maui Arts and Cultural Center, all of whom are knowledgeable about the traditional, cultural, and spiritual significance of Haleakalā.

During consultations with HALE in January 2006, the (former) HALE Superintendent expressed concerns about potential impacts from construction of the proposed ATST Project on the historic Park road. Specifically, the Superintendent commented that the historic roadway has been evaluated by NPS and Historic American Engineering Record (HAER) as eligible for listing in the National Register of Historic Places under Criterion "A" (for its development of the National Park System, the development of early NPS landscape architectural design styles, and the craftsmanship of the Civilian Conservation Corps (CCC) and Criterion "C" (for its association with rustic Park design that characterized early NPS development during the 1930s).

Formal Consultation Meeting – March 28, 2006. A letter inviting participation in a formal Section 106 consultation was sent by KCE on behalf of the NSF on February 22, 2006. This letter was sent to elected officials, agencies, organizations, and members of the community who submitted written requests to be a consulting party to the proposed ATST Project. A copy of the

letter and mailing distribution list was also sent to the SHPD and OHA. Identical public notices were published in the Maui News on March 1 and 23, 2006, the Haleakalā Times in the March 15 to 28, 2006 issue and the Maui Weekly-South in the March 16 to 22, 2006 issue.

Formal consultation meetings were held on March 28, 2006, at Mayor Hannibal Tavares Community Center and on May 1, 2006, at the Paukūkalo Community Center. The intent of both meetings was to introduce the Section 106 process to the public, discuss avoidance, mitigation and minimization proposals, answer questions and listen to testimony, request assistance in providing NSF with contact information for other Native Hawaiian organizations and individuals who may want to participate in this process, and to encourage discussion on identifying and resolving adverse impacts. Proposals arising from these interactions were received from Mr. Warren Shibuya (March 28, 2006 and August 28, 2008), Mr. Charles K. Maxwell, (March 28, 2006), and Chancellor Clyde Sakamoto, Maui Community College (May 14, 2007).

Consultation was held on March 28, 2006, with Retired Judge Boyd Mossman, Maui Trustee of OHA. NSF was given a list of additional Native Hawaiian groups that Judge Mossman recommended be invited to participate in the Section 106 process. Invitation letters dated March 31, 2006 were distributed and included a brief summary of the proposed ATST Project as it relates to the Section 106 process.

Formal Consultation Meeting – May 1, 2006. Notification postcards were sent to agencies, organizations, and members of the community announcing a second formal consultation meeting. This meeting was held on May 1, 2006 at the Paukūkalo Community Center. A copy of the postcard announcement and mailing distribution list was sent to SHPD and OHA.

Identical public notice advertisements were placed in the Maui News on April 21, 2006, the Haleakalā Times in the April 26 to May 9, 2006 issue, the Maui Weekly-South in the April 27 to May 3, 2006 issue, and posted to the ATST website. At the meeting, the public was invited to participate in the Section 106 process, public testimony was heard, written testimony was accepted, and questions were answered. During public testimony, a specific concern was heard about which organizations and individuals were contacted, the IfA's LRDP, and the NSF's role in educational outreach specifically for women and Native Hawaiians. Documentation addressing all of these concerns was posted to the ATST website within the week following the meeting.

DEIS Notification and Section 106 Resolution Proposals Status Update – June 5, 2006. On behalf of the NSF, KCE sent information postcards to agencies, organizations, and members of the community with information announcing the anticipated publication of the DEIS and the subsequent public meetings to comment on the DEIS. It also announced that scheduled meetings with interested individuals and groups who submit resolution proposals for the Section 106 process would be held during the week of the DEIS public meetings. A copy of the postcard and mailing distribution list was sent to SHPD and OHA. The information on the postcard was also published in The Maui News, The Haleakalā Times, The Maui Weekly-South, and posted on the ATST website.

OHA Formal Consultation Meeting – September 27, 2006. On September 27, 2006, NSF met again with OHA following issuance of the DEIS. That meeting took place in Honolulu with OHA Administrator, Clyde Nāmu'o. At that meeting, Mr. Nāmu'o said he was glad NSF engaged OHA early on in its Section 106 process, and he indicated that NSF was taking the right steps and engaging the right people.

Supplemental Cultural Impact Assessment (SCIA) Distribution – July 4, 2007. Extensive comments were received on the DEIS and during the Section 106 consultations concerning the proposed ATST Project's impact on historic and cultural resources. In view of these comments, NSF decided that it would be necessary to have a supplemental cultural impact evaluation prepared to assist in both its NEPA process and its ongoing Section 106 consultations. The SCIA provided by Cultural Surveys Hawai'i, Inc. substantially addressed the comments received on the DEIS and reflects additional consultative interactions requested in those comments.

ACHP Letter and Maui Community College Mitigation Proposal – November 8, 2007. The November 8, 2007, consultation letter from NSF to ACHP summarized the then current Section 106 process, including consultations with interested parties. The November 8th letter also expressed NSF's desire to hold a meeting with the consulting parties to discuss all mitigation proposals submitted to date and allow for submission of additional proposals. Finally, the letter notified ACHP of the receipt of a Mitigation Proposal from MCC, and requested a meeting with the ACHP to discuss a path forward in the consultation process. A copy of both the November 8, 2007 ACHP letter and the MCC Mitigation Proposal were sent to the consulting parties.

Formal Consultation Meeting – June 16 and 17, 2008. An invitation to attend formal Section 106 consultation meetings on June 16 and 17, 2008, was sent to all consulting parties. Those meetings were held at the University of Hawai'i Institute for Astronomy Maikalani Facility. A meeting facilitator was present as well as a court reporter.

While several consulting parties who attended the June 2008 meetings expressed concerns about and objections to the location of the proposed ATST Project, other consulting parties provided creative suggestions for mitigation provisions that could be included in a Memorandum of Agreement or Programmatic Agreement. Some of those suggestions included providing educational programs for Native Hawaiians, at both the University and K through 12 levels; locating an area for a "Hawai'i star compass" on the summit in recognition of the role navigation has played in Native Hawaiian culture; having the Native Hawaiian community identify a person with appropriate *kuleana* (responsibility) who could serve in a capacity similar to that of a *Konohiki* (headman of an *ahupua'a* [land division] under the chief) to work with the University of Hawai'i to facilitate traditional cultural practices at HO and to provide interpretation of the summit; removing the concrete remnants of the Reber Circle and cleaning up other areas on the summit; and putting a 50-year limit on the life of the proposed ATST Project. All of these suggestions and other comments by the consulting parties in attendance were considered by NSF in reaching the final PA. The transcripts of both meetings, the notes of the facilitator, and other important information containing NSF's Section 106 compliance efforts were posted on the ATST project website, which was, and continues to be consistently updated.

Follow-up from June 16 and 17, 2008 Consultation Meetings. Following the June, 2008 consultation meetings, NSF engaged in extensive conversations with the ACHP, the SHPD,

HALE, and Department of the Interior's Office of Hawaiian Relations regarding an appropriate path to move forward in its Section 106 consultation process. Concerns were expressed by the ACHP, the SHPD, and HALE regarding the outreach efforts NSF had made to include members from the Native Hawaiian Community.

On July 24, 2008, NSF sent a letter to all consulting parties inviting them to consultation meetings scheduled for the following month (on August 27th and 28th). That invitation letter was also sent to an additional 87 individuals/entities who NSF considered to be potentially interested parties because they had expressed an interest in participating in the Section 106 process at some point over the past three years, but were ultimately not included in the list of consulting parties due to inactivity and/or an apparent lack of interest. Nevertheless, NSF decided to reach out to them to provide them with another opportunity to participate in the process.

Discussions also ensued regarding expanding the Area of Potential Effect to include the Park road corridor. NSF agreed to do so. NSF continued to work closely, primarily with the ACHP, to structure the format for additional consultation meetings scheduled for August 27 and 28, 2008. In structuring the August meetings, NSF also consulted closely with HALE and reached out to the SHPD.

An second invitation letter was sent on August 15, 2008, announcing the consultation meetings scheduled to take place on August 27, 2008 at the University of Hawai'i Institute for Astronomy Maikalani Facility , was sent to all persons listed as consulting parties and those from the NHO list that had not previously been included in the process. In addition, an invitation letter was sent to those persons/entities who previously expressed an interest in NSF's Section 106 process, but who became inactive and/or demonstrated an apparent lack of interest in participating further in the process. A Public Notice announcing the August 27, 2008 consultation meetings was published in the Maui News, the Honolulu Advertiser, and the Honolulu Star Bulletin on August 24, 2008.

Both the afternoon and evening meetings on August 27, 2008, were intended to provide opportunities for consulting parties to meet with NSF to discuss ways in which to address adverse impacts to historic properties associated with the proposed ATST Project through avoidance, minimization, and mitigation. At the meetings, there were no suggestions provided by the consulting parties regarding ways in which to minimize or mitigate any adverse impacts associated with the proposed ATST Project; most of the people present stated that they were against the proposed ATST Project and that they were in favor of avoiding the impacts by not having the proposed ATST Project built at HO. NSF explained that, due to the scientific criteria required to build the proposed ATST Project, adverse impacts resulting from the color, size, and location of the proposed Project could not be avoided unless NSF were to select the No-Action Alternative and issue a decision to not fund the proposed Project's construction.

An additional meeting was held on August 28, 2008, attended only by representatives of NSF, the ATST Project team, ACHP, HALE, and SHPD, to discuss next steps in the process. It was agreed upon that NSF would host another consultation meeting to address potential impacts to the Park road corridor once a road condition survey was completed (that survey was completed in January, 2009, by the FHWA, and the final report was issued on March 4, 2009). Due to the very small attendance of consulting parties at both the June and August 2008 consultation

meetings, the NSF, ACHP, HALE, SHPD and ATST project team representatives discussed, again, ways in which to improve outreach efforts to include more participation by Native Hawaiians. That discussion continued up until the next formal consultation meetings held on June 8, 9, and 10, 2009. It should be noted that, as a cumulative result of the response to all Section 106 consultation meetings, the consulting party list comprised of agencies, Native Hawaiian organizations and individuals, and other interested individuals and community groups had grown from 64 in June 5, 2006 to 118 in August 27, 2008, to, ultimately, 141 as of today's date.

HALE Newsletter – May 2009
The NPS published a Newsletter on behalf of NPS and NSF prior to the June Section 106 consultation meetings. The Newsletter contained information about HALE's participation in the EIS process and the proposed ATST Project's need for a Special Use Permit, information about both the NEPA SDEIS Public Comment Hearings and the Section 106 consultation meetings held in June 2009. Also provided were articles about mitigation (including a discussion about what is meant by a "community benefits package"), the HALE road, the project status, as well as contact information for both NSF and HALE. The newsletter was sent to all Section 106 consulting parties and was posted to the ATST and NPS websites.

Formal Consultation Meetings – June 8, 9, and 10, 2009
Consultation meetings to solicit additional public input under Section 106 of the NHPA were held jointly by the NSF and HALE at the Kula Community Center (June 8th), the Ha'iku Community Center (June 9th), and at Maui Community College (June 10th). The consulting parties and members of the interested public were invited to participate in these meetings to provide feedback and comments regarding the Area of Potential Effect, the identification and evaluation of cultural, historic and archeological resources, and measures to avoid, minimize, and/or mitigate potential adverse impacts to these resources. Identical Public Notices were published over a three week period in the Maui News, the Honolulu Advertiser, and the Honolulu Star Bulletin newspapers. Pursuant to a prior agreement with NSF, HALE also provided information for public service announcements through local radio stations. Each meeting was conducted by a meeting facilitator.

At the meetings, many of the consulting parties expressed their position that the mountain is sacred and that spirituality cannot be mitigated. Those people and entities favored avoiding adverse effects through exercising a decision not to fund the proposed ATST Project. Several others voiced their position in favor of the proposed project. They acknowledged the cultural significance of the mountain, but specifically advocated for the inclusion of an educational program designed to address the intersection between Native Hawaiian culture and science as a mitigation measure. An additional group of consulting parties recognized the cultural significance of the mountain, but argued that adverse effects could be mitigated through a workforce development program. One individual recommended a mitigation measure that would require NSF to acquire a piece of private property on which significant cultural sites are known to be located.

Before, during, and after the June 2009 meetings, NSF received many letters from consulting parties suggesting mitigation measures. Nearly all of those letters included support for mitigating the adverse effects to cultural resources through an educational program designed to

address the intersection between Native Hawaiian culture and science. Many of those letters also suggested that the adverse effects can be mitigated through a workforce development plan. Among several other items suggested for mitigation, the Maui Native Hawaiian Chamber of Commerce advocated for "a well thought out and culturally attractive representation via artwork such as carvings of Maui and the Sun, as well as any other appropriate scenes", which are to be included on the observatory exterior. All of these letters were posted to the ATST project website.

Table 18 below sets forth the meetings and attendees for the Section 106 consultation process. Table 19 below provides the topics of concern raised during the Section 106 consultation.

Table 18. Formal Section 106 Meetings

March 28, 2006 - Meeting Location	Registered Participants	Number of Speakers*
Mayor Hannibal Tavares Community Center	14	~9

*NOTE: The number of speakers is approximate because the transcriptionist recorded unidentified speakers as well.

May 1, 2006 - Meeting Location	Registered Participants	Number of Speakers*
Paukūkalo Community Center	36	~17

*NOTE: The number of speakers is approximate because the transcriptionist recorded unidentified speakers as well.

June 16 and 17, 2008 - Meeting Location	Registered Participants	Number of Speakers
UH Maikalani Facility, Pukalani – June 16, 2009	8	9
UH Maikalani Facility, Pukalani – June 17, 2009	3	3

August 27, 2008 - Meeting Location	Registered Participants	Number of Speakers
UH Maikalani Facility, Pukalani - morning session	22	11
UH Maikalani Facility, Pukalani - afternoon session		13

June 8, 9, 10, 2009 - Meeting Location	Registered Participants	Number of Speakers
Kula Community Center	17	15
Ha'iku Community Center	19	14
Maui Community College	56	15

Table 19. Topics of Concern Raised at the Section 106 Meetings

	Topics of Concern	3/28/06	5/1/06	6/16/08	6/17/08	8/27/28 am	8/27/08 pm	HALE Notes 6/08/09	HALE Notes 6/09/09	HALE Notes 6/10/09	TOTAL
		Number of Comments for Topic									
1	Cultural, Historic and Archeological	4	9	1		3	8	5	8	9	**47**
2	Section 106 process		1	6	1	4	3		2	6	**23**
3	Mitigation process			3	3	1				2	**9**
4	HALE Issues				1	2	1	2	1	1	**8**
5	Education Component	1		2				1	2	1	**7**
6	Roadway and traffic							5	2		**7**
7	Mitigation ideas				2	1			2		**5**
8	Employment								2	2	**4**
9	Land Title		1				1			2	**4**
10	Noise		1					3			**4**
11	Biological Resources and Endangered Species							1	1		**2**
12	Decommissioning facility					1		1			**2**
13	Impact Resolution Questions	2									**2**
14	Purpose and Need							1		1	**2**
15	Section 106 Consulting Party List process			2							**2**
16	Support of Project w/Impact Resolution Proposals	1		1							**2**
17	Visual Resources and View Plane		1		1						**2**
18	Ahu distance to proposed ATST facility						1				**1**
19	Area of Potential Effect (APE)							1			**1**
20	Building design					1					**1**
21	Building Design - Color							1			**1**
22	Building Height								1		**1**
23	Community benefits						1				**1**
24	Construction timeframe							1			**1**
25	Cumulative Effects							1			**1**
26	Hazardous materials							1			**1**
27	IfA's LRDP				1						**1**
28	Infrastructure and Utilities: Paint Color		1								**1**
29	Land Use						1				**1**
30	Management Plan									1	**1**

	Topics of Concern	3/28/06	5/1/06	6/16/08	6/17/08	8/27/08 am	8/27/08 pm	HALE Notes 6/08/09	HALE Notes 6/09/09	HALE Notes 6/10/09	
		Number of Comments for Topic									TOTAL
31	Oppose Project		1								1
32	Other solar telescopes							1			1
33	Power Requirements					1					1
34	Project schedule		1								1
35	Purpose and Need	1									1
36	Reber Circle						1				1
37	Site Selection		1								1
38	Support of Maxwell as Cultural Specialist and ATST Project proposal	1									1
39	Website posting of meeting notes, transcripts							1			1
40	Who is the responsible agency for the project						1				1

Following the June 2009 consultation meetings and the close of the public comment period, NSF considered which proposals for minimization and mitigation were feasible and within NSFs authority to adopt. All proposals for minimization and mitigation proposals from interested groups and individuals were considered and as many as possible were included in a draft PA that was circulated for review by all consulting parties. Following review and comment by the consulting parties, subsequent drafts of the PA were prepared and several telephonic consultations were held. Ultimately, on September 21, 2009, the final draft was sent to all consulting parties. Those who were not either primary or invited signatories were invited to sign the PA as concurring parties. On November 13, 2009, the PA was fully executed by the primary signatories (NSF, the SHPD, the NPS, the ACHP) and the invited signatories (AURA/NSO, and the UH IfA), thus concluding NSF's Section 106 consultation process. The PA (attached hereto as Attachment A) sets forth NSF's continuing responsibilities, and those of the others who have obligations set forth therein.

In sum, pursuant to the regulations implementing the Section 106 process, 36 C.F.R. Part 800, NSF has engaged in numerous formal and informal consultations with the consulting parties, including the SHPO, the ACHP, Native Hawaiian Organizations and individuals, the NPS, and other individuals and groups regarding how to address adverse effects to historic properties, including the summit as a traditional cultural property. Those consultation efforts have resulted in the preparation of a final Programmatic Agreement, which has been fully executed by the primary and invited signatories. The PA contains on-site and off-site mitigation measures, as well as mitigation measures designed to protect and preserve HALE resources as part of the SUP. Of particular significance is that the PA includes the establishment of the ATST NHWG, which has an important consultation role in many aspects of the ATST Project.

D. ENDANGERED SPECIES ACT COMPLIANCE

In July 2005, NSF began its consultation with the USFWS, and a site visit to the primary and alternate sites for the proposed ATST Project was arranged for September 2005. On-site discussions with an avian biologist from USFWS included representatives from HALE, NSO/NOAO, IfA, and KCE. At that time, the USFWS and HALE biologists suggested that pre-construction video monitoring of the 'ua'u burrow colony adjacent to the primary site for the proposed ATST Project would be a useful tool to characterize the behavior of the 'ua'u prior to the proposed ATST Project, so that potential impacts during construction, if any, could be recognized. They also suggested that monitoring of a "control" 'ua'u colony in HALE during construction would provide a better understanding of potential impacts, if any, during construction, by comparing the behavior of 'ua'u much further away from construction activities. In response to that suggestion, NSF initiated a day/night, motion activated, video monitoring program of 30 'ua'u burrows at HO in February 2006, with video data collected during the entire nesting seasons of 2006, 2007, 2008, and 2009.

On June 15, 2006, NSF requested initiation of formal consultation for the construction and use of the proposed ATST Project, pursuant to Section 7 of the Federal Endangered Species Act of 1973, as amended (16 USC, 1531, et seq.). At that time, NSF determined that the construction of the proposed ATST Project could adversely affect the endangered 'ua'u. NSF also determined that the construction would not adversely affect the nēnē, 'ope'ape'a (Hawaiian hoary bat;

Lasiurus cinereus semotus), or 'ahinahina. During the pre-consultation and formal consultation process, NSF and USFWS worked cooperatively to develop avoidance and minimization measures to reduce impacts to listed species, specifically for the 'ua'u occupying burrows in the vicinity of the proposed ATST Project.

In a February 2007 conference call between USFWS and NSF, the USFWS concurred with the NSF determination "...that the inclusion of avoidance and minimization measures had reduced project impacts to the level of insignificance" Although not anticipated, it was agreed that if a nēnē or 'ua'u was harmed or killed as a result of ATST construction activities, work action would cease and formal consultations would be initiated with USFWS at that time.

After further consideration of the potential impacts on the 'ua'u in March 2007, e.g., the unlikely prospect of "incidental take" of 'ua'u during construction, USFWS decided to issue a Section 7 Informal Consultation Document rather than a Formal Biological Opinion. The Informal Consultation Document concurred that the proposed ATST Project is not likely to adversely affect the endangered species in question. It also circumscribed the Action Area not likely to be adversely affected by the proposed ATST Project to include the HALE summit area and Park road corridor.

As a result of discussions with HALE regarding the issuance of a Special Use Permit to traverse the Park road, it was determined that the shoulder of the road by the entrance gate would need to be temporarily widened. As a result of this development and its questionable impact on endangered species, HALE and NSF contacted the USFWS. The response from the USFWS was that no further consultation was required. Accordingly, a statement was added to Section 4.3-Biological Resources of the FEIS specifying that if an 'ua'u or nēnē is harmed or killed as a result of ATST construction activities, the USFWS would be contacted immediately and any work action would cease until the cause for the take is formally addressed.

As discussed earlier, the NPS raised several concerns about NSF's Section 7 informal consultation in its FEIS comment letter dated August 21, 2009. In particular, the NPS issued concerns with respect to the new measures proposed in the FEIS including: 1) the impacts on the nēnē at the Park's entrance station as a result of the temporarily improved shoulder; and 2) the night-time driving of oversized loads through the Park. The NPS was also concerned about whether NSF had obtained the appropriate documentation regarding a no effect determination for these issues from the USFWS. As discussed above, NSF responded to this comment letter by engaging in several discussions with both USFWS and the NPS. Following those discussions, on November 3, 2009, NSF sent a confirming e-mail to USFWS providing their no effect determination regarding the two new measures proposed in the FEIS and one additional new mitigation measure, designed to reduce noise by limiting the times for on-site and outdoor ATST-related construction activities. NSF further explained in its e-mail that, based on discussions with NPS, the night-time driving restriction previously requested by the NPS would be altered; the new restriction, designed to further protect the 'ua'u, would only allow wide and heavy loads to traverse the Park road between 12:00 noon and sunset from mid-February to mid-November of each year, and during night-time hours between mid-November and mid-February of each year (*see also* MIT-6 in Table 17, below). On November 20, 2009, the USFWS sent an e-mail to NSF concurring with NSF's no effects determination regarding these issues.

As set forth above, NSF's informal consultation with the USFWS pursuant to the Endangered Species Act resulted in a determination that the ATST Project is not anticipated to result in "take" of either 'ua'u or nēnē. After issuance of the SDEIS, however, the State of Hawaii's Department of Land and Natural Resources Division of Forestry and Wildlife (DOFAW) took issue with that result, and recommended that NSF consult with the DOFAW pursuant to Hawai'i Revised Statutes (HRS) 195D. NSF did initiate consultation with the DOFAW pursuant to HRS 195D and, as an extra measure of caution, has voluntarily decided to initiate formal consultation with USFWS so that if "take" of either 'ua'u or nēnē unexpectedly occurs during construction or operation of the ATST, the ATST Project could proceed without interruption. NSF, DOFAW, and USFWS have all agreed to work together with the goal of completing one consultation that will have the dual purpose of satisfying the requirements of HRS 195D and completing NSF's voluntary formal consultation with USFWS. If "take" is estimated to occur as a result of that consultation, any adverse impacts to the species will continue to be negligible for NEPA purposes because HRS 195D requires that mitigation measures be implemented such that adverse impacts are more than offset.

III. DECISION

The ATST presents an unparalleled opportunity to study the closest and most important star to our planet. Providing a tool to give us the ability to significantly increase our understanding of the Sun has the potential to help us predict major solar events having a profound impact on life on Earth. As explained earlier, the production of solar flares and coronal mass ejections cause variations in the solar wind, which affects terrestrial climate and determines the state of the Earth's atmosphere and magnetosphere. This, in turn, affects communication, power transmission and other activities on the Earth's surface, and presents hazards to humans in commercial air space and beyond. As recently pointed out by the National Research Council Study, considering the direct and collateral effects of severe space weather and the vulnerability of our technical infrastructure, the estimated cost of recovery from a severe geomagnetic storm scenario could be $1 trillion to $2 trillion during the first year alone with a recovery time of four to ten years. Such an impact would be devastating and the ability to predict such an event would place us in a far better position to prepare for it and address the consequences.

While there is a significant need for an instrument such as the ATST to address critical questions about the Sun, a decision to fund it must be made with a full understanding of the environmental consequences resulting from its proposed construction and operation. The process for determining and evaluating the environmental effects of the ATST Project spanned approximately five years during which NSF took great care to ensure that the environmental consequences and potential mitigation measures were fully understood. For example, when comments from the public indicated that the ATST Project would have significant adverse impacts on the summit of Haleakalā as a Traditional Cultural Property, NSF commissioned a supplemental cultural impacts study and incorporated it into its analysis of environmental consequences. Likewise, when it became clear that there were other substantive public comments on the DEIS that warranted further study, including the comment to increase the Region of Influence of study to include impacts on Haleakalā National Park, NSF prepared the SDEIS.

Yet another example of NSF's commitment to its environmental compliance process can be found in its consultation efforts carried out pursuant to Section 106 of the NHPA. As detailed above, NSF held over 30 formal and informal consultation meetings and in response to input from consulting parties, it increased its list of consulting parties to over 140. The result of its Section 106 consultation process is the Programmatic Agreement, which provides many innovative ways to address the significant impacts to cultural resources resulting from the ATST, including an ongoing role (through the ATST NHWG) for Native Hawaiian Organizations to continue to offer input into certain aspects related to the construction and operation of the ATST. The ATST NHWG was established for the purpose of mitigating adverse effects by bridging the cultural and spiritual issues related to the construction and operation of the ATST during the planning, construction, and operation, of this undertaking.

Of the three alternatives that were analyzed in the FEIS (the Preferred Mees site, the Alternative Reber Circle site, and the No-Action Alternative), I have decided to select the Preferred Mees site, which is also the environmentally preferred alternative. As explained above and more thoroughly in the FEIS, construction and operation of the ATST at the Mees site will result in several major, adverse impacts to various resources. While all efforts have been made to reduce those impacts, some impacts will remain even with the implementation of significant mitigation measures. The mitigation measures to be implemented, however, are indeed significant and represent a dedicated multi-year effort by NSF to address and reduce adverse impacts.

Perhaps the most significant major, adverse impact the ATST will have is the impact on traditional cultural resources on the summit area of Haleakalā as a Traditional Cultural Property. The environmental compliance process indicated that the ATST will be considered by some to be an intrusion on a sacred site. The mere presence of the ATST will potentially disturb traditional cultural practices conducted within the ROI. Likewise, additional personnel associated with the construction and operation will, by accessing and working at the site, potentially disturb traditional cultural practices which will result in a major, adverse, long-term impact. Although mitigation measures will be implemented to avoid impacts, the potential for major adverse impacts remains. While NSF acknowledges that for some impacts, such as those to spirituality, mitigation may not be possible, implementation of the PA is anticipated to reduce impacts to some cultural resources through fostering a better understanding of cultural resources and practices, demonstrating ways of showing respect to the Native Hawaiian culture, and decommissioning and deconstructing the ATST within 50 years of the commencement of full operations, unless, after consultation with Native Hawaiian Organizations, it is determined otherwise. Additional efforts to attempt to mitigate adverse impacts to cultural resources are set forth in the PA.

Construction-related noise at the Preferred Mees site will also result in major, adverse, short-term impacts on the noise setting and, thus, the visitor use and experience within the Park, specifically in certain regions of HALE along the Park road corridor. While mitigation measures will be in place to limit the sources and timing of these noise impacts, these mitigation measures will not fully eliminate these short-term adverse impacts.

At the Preferred Mees site, there will also be a major, adverse, long-term impact on visual resources for HALE visitor use and experience once the ATST facility is erected. The fully

constructed facility will be visible from Pu'u Ula'ula Overlook, the western edge of the Haleakalā Visitor's Center, the summits of Pa Ka'oao and Magnetic Peak, and along the Park road corridor nearing HO. These impacts will last for the life of the ATST facility, will continue to affect visitor expectations of the summit natural vistas, and no mitigation will adequately reduce the intensity of this impact.

While the major adverse impacts articulated above will result from constructing and operating the ATST at the Mees site, NSF commits to take whatever actions are reasonable and practicable to preserve and protect the natural and cultural environment. The mitigation measures set forth in Table 17 are a reflection of this strong commitment. While NSF will not be able to reduce all adverse impacts to lower intensity levels, the scientific gains that the ATST will provide have the potential to yield a significant benefit to life on Earth. The ATST is founded on one of NSF's fundamental missions, which is to support the scientific community's objectives to achieve unprecedented progress in solar observation. Any measurement of long-term productivity in this context must include the overriding importance of advancing knowledge of the Sun, both as an astronomical object and as the dominant external influence on Earth, by providing forefront observational opportunities to the research community.

Selection of the No-Action Alternative would limit solar astronomy to current technologies and delay critical measurements of the "reach" of the Sun's coronal magnetic field into the Sun-Earth space environment, and the measurement of the small scale evolution of magnetic fields that control the generation, evolution, and decay of sites of solar activity. Since existing instrumental capabilities at facilities such as the MSO facility no longer are sufficient to take this next step toward understanding the fundamental physical processes that govern the behavior of the Sun, and because no facilities capable of observing the magnetic phenomena in the solar atmosphere at the required level of detail, knowledge of the direct effects of solar activity on life on Earth would not be forthcoming.

When it begins full science operation in 2017, the ATST will be the world's flagship facility for the study of magnetic phenomena in the solar atmosphere and will be the first large, ground-based, open-access U.S. solar telescope constructed in more than 40 years. The ATST observations will enable a complete picture of the Sun spanning from the interior to interplanetary space to be developed. An understanding of the role of magnetic fields in the outer regions of the Sun is critical to understanding the solar dynamo, solar variability, and solar activity, including flares and mass ejections which can affect life on Earth.

At its August 6, 2009 Board Meeting, after reviewing the scientific merit of the ATST and the sufficiency of the project management plan, the National Science Board authorized me, at my discretion, to approve funding for construction of the ATST, subject to completion of the Federal environmental compliance requirements. I have considered the scientific merit of the ATST, the project management plan, and the environmental consequences and mitigation measures associated with construction of the ATST at the Mees site. As part of my consideration of the environmental consequences, I visited the two locations of the action alternatives, the Mees site and the Reber Circle site. After thorough consideration of the record, I conclude that, although major adverse environmental impacts will result, the construction of the ATST at the Mees site represents an opportunity to implement a critical and unique astronomical resource that is

expected to be useful and innovative for several decades to come. Increasing our understanding of the Sun and its ability to affect life on Earth will go a long way toward helping us to predict certain catastrophic events and provide us with the opportunity to address the potential consequences. Accordingly, I hereby approve the funding of the construction of the ATST Project at the Preferred Mees site.

12/3/2009
Date

Dr. Arden L. Bement, Jr.
Director
National Science Foundation

ATTACHMENT A

PROGRAMMATIC AGREEMENT
among
The National Science Foundation,
The National Park Service,
The Advisory Council on Historic Preservation,
The Hawai'i State Historic Preservation Officer,
The Association of Universities for Research in Astronomy, and
The University of Hawai'i (for the benefit of its Institute for Astronomy)
Regarding the Advanced Technology Solar Telescope Project,
Haleakalā, Maui, Hawai'i

WHEREAS, the National Science Foundation (NSF) received a proposal from the Association of Universities for Research in Astronomy (AURA) to fund the construction and operation of the Advanced Technology Solar Telescope (ATST Project). If approved by NSF, the proposed ATST Project would be located within the University of Hawai'i (for the benefit of its Institute of Astronomy) (UH IfA) Haleakalā High Altitude Observatory (HO) site at the summit of Haleakalā, County of Maui, Hawai'i. If the proposed ATST Project is approved for funding by NSF, this Programmatic Agreement (PA), prepared pursuant to 36 C.F.R. § 800.14(b), shall be effective for a period of ten (10) years beginning from the "Effective Date" defined in Section IV. K., herein. If unresolved issues remain within two years of the expiration date of this PA, NSF shall consult with the other Signatories regarding the appropriateness of developing a subsequent agreement;

WHEREAS, the Haleakalā National Park (HALE) road is the only access to HO and, therefore, the National Park Service (NPS), pursuant to 36 C.F.R. § 5.6, is mandated to issue a Special Use Permit (SUP) to allow commercial vehicles to operate on the HALE road during the construction and operation phases of the proposed ATST Project;

WHEREAS, the "proposed Undertaking" that is the subject of this PA encompasses both the construction and the initial phase of the operation of the proposed ATST Project, which includes an observatory facility, telescope enclosure, support and operations building, utilities building, and parking area. The proposed Undertaking will, if approved, also include all of the following activities in support of the ATST Project construction and operation: land clearing, demolition activities, grading/leveling, excavation, soil retention and placement, construction, remodeling of the Mees Solar Observatory building, paving, and other site improvements. The proposed Undertaking further includes the use of the HALE road for the construction and operation of the ATST Project, in accordance with the SUP to be issued by the NPS. Because of the complexity of the proposed Undertaking and its impacts on historic properties (as that term is defined in 36 C.F.R. § 800.16(l)(1)) within the Haleakalā summit area, a Traditional Cultural Property (TCP), this PA has been prepared in accordance with 36 C.F.R. § 800.14(b);

WHEREAS, NSF has defined, and by letter of July 21, 2009, the State of Hawai'i State Historic Preservation Officer (SHPO) concurred that the Area of Potential Effects (APE) for the proposed Undertaking includes the HO site, a 50-foot corridor along the historic

Haleakalā National Park road measured 25 feet from each side of the center line (Park Road Corridor), both of which are located within the Crater Historic District. HO and part of the Park Road Corridor are also located within the Haleakalā summit area, a TCP. A map of the APE and a tax map are attached hereto as, "Exhibit A";

WHEREAS, NSF, through the consultation process set forth in Section 106 of the National Historic Preservation Act, 16 U.S.C. 470f (NHPA) (the Section 106 consultation process), has determined, in consultation with the SHPO, that the summit of Haleakalā is a historic property that has spiritual and cultural significance to Native Hawaiians (Kanaka Maoli) and is a TCP that satisfies the criteria to be eligible for listing on the National Register of Historic Places (National Register);

WHEREAS, through the Section 106 consultation process, it is acknowledged that Haleakalā has spiritual and cultural significance, and is a very sacred place to Kanaka Maoli and continues to be used by them for ceremonial practices;

WHEREAS, through the Section 106 consultation process, it is acknowledged that the proposed Undertaking will have an adverse effect on the TCP and associated cultural practices as a result of the location, height, volume, and color of the proposed observatory facility, telescope enclosure, support and operations building, utilities building, and parking area for the proposed ATST Project;

WHEREAS, the Park Road Corridor is located within the Crater Historic District, which is listed on the National Register and the State of Hawai'i Inventory of Historic Places. The Park Road Corridor is also partially located within the Haleakalā summit area, a TCP. The historic properties within the Park Road Corridor have been determined eligible for listing on the National Register by the NPS in consultation with the SHPO;

WHEREAS, NSF has coordinated with the NPS on ways to avoid, minimize, or mitigate the adverse effects the proposed Undertaking has on historic properties pursuant to the regulations implementing Section 106 of the National Historic Preservation Act, 16 U.S.C. 470f (NHPA), 36 C.F.R. Part 800. NPS, because of its role in issuing the SUP, has Section 106 responsibilities for this Undertaking, and has, therefore, participated in the development of this PA and is a Signatory herein in order to fulfill those duties;

WHEREAS, NSF has consulted with the SHPO on ways to avoid, minimize, or mitigate the adverse effects the proposed Undertaking has on historic properties pursuant to the regulations implementing Section 106 of the NHPA, 36 C.F.R. Part 800. The SHPO participated in the development of this PA and is a Signatory herein;

WHEREAS, the Advisory Council on Historic Preservation (ACHP) has participated in the Section 106 consultation process, pursuant to 36 C.F.R. § 800.2(b), and NSF has consulted with the ACHP on ways to avoid, minimize, or mitigate the adverse effects the proposed Undertaking has on historic properties pursuant to the regulations implementing Section 106 of the NHPA, 36 C.F.R. Part 800. The ACHP participated in the development of this PA and is a Signatory herein;

WHEREAS, AURA, through the National Solar Observatory (NSO or AURA/NSO), is the ATST project applicant. AURA/NSO will be responsible for the construction, installation, operation, and management of the proposed ATST Project if it is approved. Because it is the ATST project applicant, AURA/NSO has participated as a consulting party in NSF's Section 106 consultation process for the proposed ATST Project pursuant to Section 106 of the NHPA. AURA/NSO participated in the development of this PA and was invited to sign as a Signatory herein;

WHEREAS, UH IfA has the responsibility for the overall control and management of HO. UH IfA has also developed the Long Range Development Plan (LRDP) for HO, which includes Best Management Practices directed at the preservation and protection of cultural, archeological, and historic resources outlined in Section 9.3.2 of the LRDP for HO, attached hereto as, "Exhibit B." Accordingly, UH IfA has participated as a consulting party in NSF's Section 106 consultation process for the proposed ATST Project. UH IfA participated in the development of this PA and was invited to sign as a Signatory herein;

WHEREAS, NSF has identified and consulted with Native Hawaiian Organizations (NHOs) and Kanaka Maoli on ways to avoid, minimize, or mitigate the adverse effects the proposed Undertaking has on historic properties pursuant to the regulations implementing Section 106 of the NHPA, 36 C.F.R. Part 800, and invited them to participate in this process as consulting parties. Those NHOs who became consulting parties were invited to participate in the development of this PA and sign herein as Concurring Parties. A list of NHOs who became consulting parties in this Section 106 consultation process is attached hereto as "Exhibit C";

WHEREAS, NSF has identified through both the Section 106 and National Environmental Policy Act processes other interested parties and members of the public who were interested in participating in NSF's Section 106 consultation process as consulting parties. NSF consulted with those who joined NSF's process as consulting parties on ways to avoid, minimize, or mitigate the adverse effects the proposed Undertaking has on historic properties pursuant to the regulations implementing Section 106 of the NHPA, 36 C.F.R. Part 800. NSF also invited all consulting parties to participate in the development of this PA and sign as Concurring Parties;

WHEREAS, NSF carried out consultation by holding over 30 formal and informal consultation meetings that took place both in person and via teleconference during the period from January, 2006, through August, 2009; and

NOW, THEREFORE, NSF, the ACHP, the SHPO, the NPS, AURA/NSO, and UH IfA (collectively referred to herein as, "the Parties" or "the Signatories") agree that NSF shall ensure that this PA will be implemented after the Effective Date, as defined in Section IV. K. of this PA; the NPS shall ensure that all stipulations listed under Section III of this PA (NPS Area of Responsibility) are implemented.

STIPULATIONS

NSF, in coordination with the proposed ATST Project applicant, AURA/NSO, shall ensure that all of the stipulations in Sections II (NSF Area of Responsibility) and IV (Administrative Stipulations) of this PA are carried out. NPS shall ensure that all stipulations under Section III (NPS Area of Responsibility) are carried out.

I. Roles and Responsibilities

On the Effective Date, as defined in Section IV. K., herein, the following entities are obligated to carry out their distinctive roles and responsibilities as set forth in this PA:

A. NSF

NSF is the lead federal agency responsible for ensuring that the measures in this PA are carried out. NSF's primary areas of responsibility are set forth in Sections II and IV of this PA. NSF's role includes both directly carrying out certain activities and working with non-federal entities to ensure that certain stipulations contained in this PA are implemented.

B. NPS

The NPS is a federal agency that has a co-lead responsibility with NSF for ensuring that the measures in this PA are carried out. The NPS' role in this PA derives from its issuance and enforcement of the SUP and, as such, the NPS is responsible for ensuring that the stipulations in Section III of this PA are implemented.

C. AURA/NSO

AURA/NSO is the project applicant and, as such, has specific responsibilities throughout this PA related to the construction and operation of the ATST Project. Some of these responsibilities are to be carried out solely by AURA/NSO, and others are shared with NSF and/or non-federal entities. The responsibilities of AURA/NSO will be assumed by any successor entity.

D. UH IfA

The HO site, which is near the summit of Haleakalā, is under the management and control of the UH through its IfA. The IfA establishes and enforces policies regarding access, use, and protection of HO. Under this PA, should the proposed ATST Project be approved for construction, UH IfA has specific responsibilities, some of which are shared with AURA/NSO and others which must be carried out in consultation with the ATST Native Hawaiian Working Group (ATST NHWG) and the SHPO.

E. SHPO

The SHPO's role in this PA is one of consultation with those parties having responsibilities for carrying out certain provisions of this PA.

F. ACHP

The ACHP's role in this PA is one of consultation and, also, to assist in the administration of this PA, particularly the resolution of disputes that may arise during post agreement activities.

G. ATST NHWG

The ATST NHWG's role in this PA is one of consultation concerning historic property matters related to the construction and operation of the ATST Project. This group will be established pursuant to Section II. A. of this PA to assist NSF, AURA/NSO, and UH IfA in carrying out their responsibilities under this PA.

H. CONSULTING PARTIES AND THE PUBLIC

All consulting parties, regardless of whether they elected to sign as a Concurring Party to this PA, and members of the public may continue to participate in this Section 106 consultation process by reviewing the status of implementation of this PA through information available on either the project website or at the project office and by raising any objection pertaining to the treatment of an historic property associated with the construction or operation of the proposed ATST Project. The process for raising such an objection is set forth in Section IV. F. of this PA.

II. NSF Area of Responsibility

A. Establishment of the ATST Native Hawaiian Working Group

NSF shall establish the "ATST Native Hawaiian Working Group," (defined previously as the "ATST NHWG"), comprised of NHOs, whose representatives will serve on a volunteer basis to provide input to NSF, AURA/NSO, and UH IfA on historic property matters related to the construction and operation of the ATST Project as referred to in this PA. The ATST NHWG shall formally meet twice each year; the first meeting shall take place within 60 days from the date this PA is fully executed by all Signatories (which may occur before the "Effective Date" of this PA, as defined in Section IV. K., herein). Informal contact may occur at any time on an as-needed basis. A framework for conducting the ATST NHWG shall be established by NSF during, or within a month after, the first formal meeting of the ATST NHWG. Any NHO that served as a consulting party in this Section 106 consultation process, but elected not to sign this PA as a Concurring Party, shall not be precluded from becoming a member of the ATST NHWG.

B. Implementation of Best Management Practices

AURA/NSO and UH IfA will, if the proposed Undertaking is approved, jointly implement the Best Management Practices directed at the preservation and protection of cultural, archeological, and historic resources outlined in Section 9.3.2 of the UH IfA Long Range Development Plan (LRDP) for HO (*see* Exhibit B).

C. Naming of HO Roads

UH IfA will consult with the ATST NHWG regarding the naming of the roads within HO and, informed by such consultation, will take reasonable steps to pursue the naming of the roads, recognizing that such naming is subject to state review and approval. UH IfA will work with AURA/NSO to post the decision regarding the naming of the roads within HO on the project website.

D. Retaining a Cultural Specialist

AURA/NSO will, after consultation with the ATST NHWG, hire a Cultural Specialist, as defined in Section 9.3.2 of the LRDP, to help ensure protection of existing historic properties and their traditional cultural values during construction. The Cultural Specialist will be a Kanaka Maoli, preferably a kupuna (elder) and if possible a kahu (clergyman) as well, and one who has knowledge of the spiritual and cultural significance and protocol of Haleakalā. The Cultural Specialist's knowledge should be concentrated in traditional and cultural practices and protocols. This commitment is consistent with consultations held during this Section 106 consultation process and Hawaiian culture. The formal involvement of a Cultural Specialist who understands Native Hawaiian culture is important for this site.

E. Decommissioning of the ATST

In all cooperative agreements governing the operation of the ATST Project entered into between NSF and AURA/NSO (or any successor entity), NSF shall include a provision requiring NSF to decommission and deconstruct the ATST Project within fifty (50) years from the date operations commence, unless, after consultation by NSF with NHOs, NSF decides otherwise, in which case NSF shall notify the ACHP, the SHPO, and the NPS.

F. Possible Repainting

In all cooperative agreements governing the operation of the ATST Project entered into between NSF and AURA/NSO (or any successor entity), NSF shall include a provision requiring the responsible entity to periodically [every two (2) years following the effective date of each cooperative agreement] reassess technological options for new types of coatings, more efficient cooling methods, or improved compensation for thermal turbulence, which may allow the ATST enclosure and buildings to be painted a color other than white to make the structures less noticeable, as requested by consulting parties during the Section 106 consultation process. If NSF and AURA/NSO (or any successor entity) determines that such future technology is an effective, reliable, and affordable solution that meets the scientific requirements of the ATST Project, NSF will consult with the ATST NHWG and the NPS regarding the repainting of the exterior structures of the ATST enclosure and buildings with a more neutral color. If the result of such consultation is that repainting is favored by the ATST NHWG and NPS, NSF will work with AURA/NSO (or any successor entity) to repaint the exterior structures of the ATST enclosure and buildings with a more neutral color.

AURA/NSO will post the results of each bi-annual reassessment of technological options on the project website.

G. Removal of Unused Facilities at HO

UH IfA, subject to funding and authorizations, will remove facilities, poles, antennae, and lines at HO that are determined by UH IfA to be unused or in excess of that which is needed. The removal of any such facilities, poles, antennae, or lines at HO pursuant to this stipulation shall be reported on the project website.

H. Removal of Reber Circle Site #50-50-11-5443

AURA/NSO, with the approval of UH IfA, shall remove Reber Circle Site #50-50-11-5443 in accordance with the data collection and documentation requirements set forth in the letter from Peter Young, Chair of the State Board of Land and Natural Resources and the State Historic Preservation Officer, State of Hawai'i Department of Land and Natural Resources to Erik Fredericksen, Xamanek Researchers, regarding Data Recovery Plan for SIHP 50-50-11-5443, dated June 14, 2006. After the removal is completed, AURA/NSO will post notice of such removal on the project website.

I. Hawaiian Star Compass

NSF, AURA/NSO, and UH IfA, in consultation with the ATST NHWG, will evaluate the feasibility of locating an area for a Hawaiian star compass at the summit. If determined feasible and subject to funding and authorizations, NSF, AURA/NSO and UH IfA will place the Hawaiian star compass at the designated site. The decision regarding feasibility and the final result will be provided to the ATST NHWG and posted on the project website.

J. Required "Sense of Place" Training

In order to sensitize them to the significance of Haleakalā as a TCP, all employees, including scientists/researchers who engage in any on-site construction or operation activities associated with the proposed ATST Project, shall undergo UH IfA approved "Sense of Place" training, as set forth in the LRDP. Specifically, NSF, through AURA/NSO, will ensure that all persons involved with the construction and operations of the ATST Project shall be required, within a thirty (30) day period of commencing their job, to attend a worker orientation session and view a UH IfA approved "Sense of Place" training videotape and/or presentation which shall address the historic/cultural significance of Haleakalā to Native Hawaiians. AURA/NSO will maintain a list that can be periodically reviewed by the Signatories and Concurring Parties, of all personnel attending the worker orientation sessions and viewing the training videotape. AURA/NSO will also notify the ATST NHWG of the selection of the training provider.

K. Exterior Design

AURA/NSO, in consultation with the ATST NHWG and the NPS, will incorporate a representation of traditional Hawaiian culture suitable to the Haleakalā setting, such as artwork depicting Maui and the Sun or other appropriate motifs, on the exterior design for the lower portion of the ATST building.

L. Possible Shelter for Cultural Practitioners

NSF, UH IfA, and AURA/NSO, in consultation with the SHPO, the ACHP, and the ATST NHWG, will determine the feasibility of a shelter at HO, with access to restroom facilities, for use by Native Hawaiian cultural practitioners. Consultations will include the location, design, and use of such a shelter. If determined feasible, and subject to available funding, NSF will fund the shelter.

M. State Road 378

NSF, through AURA/NSO, will fund an assessment of historic properties associated with State Road 378 similar to the assessment entitled, "Historic American Engineering Record Haleakala Highway HAER No. HI-52" that was done for the Park road. The scope of work for this assessment shall be developed by AURA/NSO in consultation with the SHPO. Prior to construction of the ATST Project (if approved), AURA/NSO will ensure that all historic properties along State Road 378 are photographed and documented. In addition, AURA/NSO will avoid adverse effects to and preserve the integrity of State Road 378 during the construction phase of the proposed ATST Project to the extent feasible. Where adverse effects cannot be avoided, AURA/NSO, in consultation with the SHPO and the Hawai'i State Department of Transportation, will develop and ensure the implementation of a SHPO approved scope of work to repair any damage caused by the proposed ATST Project.

N. Acknowledgment of Significance of Haleakalā and NSF's Gratitude

NSF and AURA/NSO will ensure that all scientific publications and other scholarly work utilizing data obtained with the ATST will be required to include either a footnote on the title page or an entry in the "Acknowledgment" section that: 1) notes that the ATST is located on land of spiritual and cultural significance to the Kanaka Maoli; and 2) acknowledges NSF's gratitude for the use of this important site to the Kanaka Maoli. The exact wording of the acknowledgment will be developed by NSF and AURA/NSO in consultation with the ATST NHWG.

O. Status of Implementation of this PA Reported on Project Website

To keep the public and all consulting parties apprised of the status of the implementation of the Stipulations in this PA, AURA/NSO will maintain the project website with relevant information. In addition, as required by Sections II. C., F., G., H., I., and III. A., specific information regarding the obligations set forth in those Stipulations will be posted on the project website. Hard copies of

this information will also be made available to the public and all consulting parties at the ATST Project office.

III. NPS Area of Responsibility

The NPS, as the entity responsible for issuing and overseeing the SUP, shall be responsible for ensuring that the following stipulations are carried out:

A. Documentation of Historic Features within the Park Road Corridor

AURA/NSO, in coordination and consultation with the NPS and pursuant to the terms of the SUP, will ensure that all historic features associated with the Park Road Corridor are photographed and documented prior to and after construction of the ATST Project. AURA/NSO shall submit such photographs and documentation to the NPS and post them on the project website.

B. Limitations on Heavy Loads

AURA/NSO, pursuant to the terms of the SUP, will ensure and certify to the NPS that no loads heavier than the current load rating for the historic Park bridge will be allowed within the Park Road Corridor.

C. Temporary Improvement of Shoulder at HALE Entrance

AURA/NSO, pursuant to the terms of the SUP, will temporarily improve the shoulder of the in-bound lane at the Park entrance to accommodate wide loads. After the improved shoulder is no longer needed, AURA/NSO, in accordance with the SUP, will restore it to its original condition.

D. Limitations on Number of Wide Loads

AURA/NSO, pursuant to the terms of the SUP, will ensure that the number of wide loads will not exceed 25, including no more than two loads up to 10 meters (32 feet, 10 inches), over the course of the construction phase of the ATST Project. AURA/NSO will ensure that these wide loads will not exceed the clearances along the Park Road Corridor and that the vehicles transporting such wide loads will avoid driving on the edges of the road.

E. Time Limitations on Construction Traffic

AURA/NSO will coordinate with HALE to establish time periods during which construction traffic, especially slow moving and/or FHWA Class 5 or larger vehicles, can traverse the Park Road Corridor. The NPS will ensure that these time limitations are set forth in the SUP.

F. Time Limitations on Construction Activities

AURA/NSO, in accordance with the terms of the SUP, will ensure that outside, on-site, construction activities will be limited daily to between 30 minutes after sunrise and 30 minutes prior to sunset.

G. SUP Monitor

AURA/NSO, in accordance with the terms of the SUP, will fund a NPS monitor to ensure that the SUP referred to in this PA is followed. Any non-compliance with the SUP will be dealt with by the NPS in accordance with 36 C.F.R. Part 1.6. The NPS shall report any non-compliance with the SUP related to historic features within the Park Road Corridor to the SHPO and the ACHP.

H. Reimbursement for Damage to Historic Features

AURA/NSO, pursuant to the terms of the SUP, will reimburse the NPS for any expenditure required for repairing damage to historic features within the Park Road Corridor, if such damage results from construction-related traffic associated with the ATST Project. In the event that such damage occurs, the NPS will notify the SHPO.

I. Reasonable Deviations in Exceptional Circumstances Reviewed by Park Superintendent

Pursuant to the terms of the SUP, the Park Superintendent may, in exceptional circumstances, authorize reasonable deviations from paragraphs III. B., D., E., and F., above. AURA/NSO will request such deviations from the Park Superintendent in advance. The Park Superintendent will review the request and render a decision to approve, deny, or approve with conditions. If any historic resources may be impacted as a result of such reasonable deviations, the NPS will promptly notify the SHPO and the ACHP.

IV. ADMINISTRATIVE STIPULATIONS

A. Compliance with Applicable Law and Anti-Deficiency Provision

This PA shall be carried out consistent with all applicable federal and state laws. No provision of this PA shall be implemented in a manner that would violate the Anti-Deficiency Act. All obligations on the part of NSF and the NPS shall be subject to the availability and allocation of appropriated funds for such purposes. While NSF and the NPS will make efforts to seek adequate funding to carry-out the terms of this PA, should NSF or the NPS be unable to fulfill the terms of this PA due to funding constraints, the relevant agency will immediately notify the ACHP, the SHPO, and the other Signatories, and consult with them to determine whether to amend or terminate the PA pending the availability of resources. All obligations on the part of UH IfA herein shall be subject to the availability and allocation of appropriated funds for such purposes and UH IfA obtaining all of the necessary authorizations. While UH IfA will make efforts to seek adequate funding and the necessary authorizations to carry-out UH IfA's obligations under the terms of this PA, should UH IfA be unable to fulfill the terms of this PA due to funding constraints or lack of necessary authorizations, UH IfA will immediately notify NSF, the NPS, the ACHP, the SHPO, and the other Signatories, and consult with them to determine whether to amend or terminate

this PA pending the availability of resources and the receipt of the necessary authorizations.

B. Discoveries

All unanticipated discoveries of historic properties and human or burial remains within the APE revealed during the construction and operation phases of the ATST Project shall be addressed in the following manner:

1. AURA/NSO shall promptly notify NSF, the SHPO and the ATST NHWG of the discovery.

2. If NSF determines, in consultation with the SHPO, that the discovery is eligible for listing in the National Register, NSF will initiate consultation with the consulting parties to draft a plan with measures that will avoid, minimize, or mitigate adverse effects. If agreement is reached regarding such a plan, NSF shall implement the plan. If the discovery is made during the construction phase, construction in the affected area must cease until the discovery process in this Stipulation has been concluded either through a finding that the property is not eligible for listing in the National Register, or through finalization of the plan referenced herein.

3. If the consulting parties cannot reach agreement regarding the development of a treatment or mitigation plan, then the matter shall be referred to the ACHP for guidance. NSF shall address the ACHP's guidance in reaching a final decision regarding implementation of the plan.

4. If any previously unidentified human or burial remains are discovered during implementation of the Undertaking, AURA/NSO shall immediately cease construction work and adhere to applicable state and federal laws regarding the treatment of human or burial remains.

With regard to any previously unidentified discoveries found within the Park Road Corridor, the process outlined in Sections IV. B.1. through 4., above, shall apply except that NPS shall replace NSF as the relevant federal agency.

C. Duration

This PA will expire ten (10) years from the Effective Date of this PA as defined in Section IV. K., herein. Prior to such expiration date, NSF may consult with the other Signatories to reconsider the terms of this PA and amend it in accordance with Stipulation IV. H., below. If unresolved issues remain within two years of the expiration date of this PA, NSF shall, at that time, consult with the other Signatories regarding the progress of implementation of this PA and to consider the appropriateness of developing a subsequent agreement or amendment to the PA.

D. Incorporation of PA in Future Cooperative Agreements and Reference to PA in Construction-Related Agreements

This PA shall be incorporated into all future cooperative agreements entered into between NSF and any entity responsible for carrying-out the construction and operation phases of the ATST Project. If AURA/NSO is no longer the entity responsible for carrying-out the construction and operation phases of the ATST Project, the successor entity shall assume all responsibilities under this PA where AURA/NSO currently appears. This PA shall also, as appropriate, be referenced in construction-related agreements.

E. Dispute Resolution

In the event one of the Signatories objects to the manner in which any term of this PA is implemented, the following dispute resolution process shall be followed:

1. The objecting Signatory shall notify all other Signatories to this PA, in writing, of the objection or disagreement, request written comments on the objection or disagreement within ten (10) business days following receipt of such notification, and then proceed to consult with the Signatories to resolve the objection. If at any time during consultation, NSF determines that the objection or disagreement related to the construction or operation of the ATST Project cannot be resolved through consultation, NSF shall forward all documentation relevant to the dispute to the ACHP. Within 30 days after receipt of all pertinent documentation, the ACHP will provide NSF with comments and recommendations, which NSF will take into account in reaching a final decision regarding the dispute. Any recommendation or comment provided by the ACHP will be understood to pertain only to the subject of the dispute. The responsibility of NSF to carry out all actions under this PA that are not the subject of the dispute will remain unchanged.

2. With regard to any dispute regarding the terms of this PA related to HALE, the process outlined in Section IV. E.1., above, shall apply except that the NPS shall replace NSF as the relevant federal agency.

3. Unless the Signatories agree that the dispute warrants a cessation of construction work, AURA/NSO will not be required to cease construction work on the ATST Project while the dispute is being reviewed.

F. Continued Participation by the Public and Consulting Parties

At any time during the implementation of the Stipulations set forth in this PA, any member of the public and any consulting party, including a consulting party who has decided not to sign this PA as a Concurring Party, may continue to participate in the Section 106 consultation process as follows:

1. Any member of the public may raise an objection to NSF pertaining to the treatment of an historic property associated with the construction or operation of the ATST Project (if approved). In the event such an objection is raised, NSF shall consult with the SHPO regarding the objection, and, following such consultation, will provide the objecting member of the public with a decision on the objection.

2. Any consulting party, including any consulting party who has decided not to sign this PA as a Concurring Party, may raise an objection to NSF and the SHPO pertaining to the treatment of an historic property associated with the construction or operation of the ATST Project (if approved). In the event such an objection is raised by a consulting party, NSF and the SHPO shall consult regarding how to resolve the objection. If NSF and the SHPO are unable to resolve the objection, they shall consult with the ACHP. NSF will consider any advice on the objection provided by the ACHP within 10 days of being notified of it, before making a final decision on the matter. NSF will communicate such a final decision to the objecting consulting party and the Signatories.

If an objection is made pursuant to either Section IV. F.1. or F.2., above, NSF, in consultation with the SHPO, will determine whether the objection warrants a cessation of construction work on the ATST Project while the objection is being reviewed.

G. Follow-up Meetings to Discuss Implementation

NSF will invite the Signatories to this PA to a meeting and/or teleconference every three years to discuss implementation of the terms of this PA and determine whether revision, amendment, or termination is needed. NSF shall schedule the first such meeting/teleconference within three years of the Effective Date of this PA, as defined in Section IV. K., herein.

H. Amendments and Noncompliance

This PA may be amended upon written agreement by all of the Signatories, including the invited Signatories, herein.

I. Termination

If any Signatory to this PA, including any invited Signatory, determines that the terms of this PA will not or cannot be carried out, that Signatory shall immediately consult with the other Signatories to develop an amendment to this PA pursuant to Section IV. H., above. If this PA is not amended following that consultation, then it may be terminated by any Signatory or invited Signatory through written notice to all other Signatories. Within thirty (30) days following termination, NSF shall notify the Signatories if it will initiate consultation to execute a new PA with the Signatories under 36 C.F.R. § 800.6(c)(1) or request and consider the comments of the ACHP under 36 C.F.R. § 800.7 and proceed accordingly.

J. Effect of PA Execution

Execution of this PA by NSF, the ACHP, the SHPO, the NPS, AURA/NSO, and UH IfA prior to NSF's approval of the proposed ATST Project and NPS' issuance of the SUP, evidences that NSF and the NPS have taken into account the effects of this proposed Undertaking on historic properties, and have afforded the ACHP an opportunity to comment on the proposed Undertaking.

K. Effective Date

This PA shall be executed in counterparts, with a separate page for each Signatory, and NSF shall ensure that each Signatory is provided with a fully executed copy. This PA will become effective upon:

1. Execution of this PA by NSF, the NPS, the SHPO, AURA/NSO, UH IfA, and the ACHP;

2. A decision by the NSF Director authorizing the funding of the construction of the proposed ATST Project;

3. The issuance of the SUP by the NPS;

4. Receipt of a Conservation District Use Permit from the State of Hawai'i Board of Land and Natural Resources; and

5. The execution of a lease between the UH IfA and AURA/NSO and/or NSF for the property within HO upon which the ATST Project would, if approved, be built.

Nothing, however, shall preclude NSF from initiating the establishment of the ATST NHWG prior to the effective date of this PA.

Attachments: **Acronym Key**
Exhibit A (Map of the Area of Potential Effects (APE) and Tax Map Key)
Exhibit B (Best Management Practices Excerpted from the Long Range Section 9.3.2. of the Long Range Development Plan for the Haleakalā High Altitude Observatory)
Exhibit C (List of Native Hawaiian Organizations that Are Consulting Parties)

SIGNATORIES TO THIS PROGRAMMATIC AGREEMENT:

FOR THE NATIONAL SCIENCE FOUNDATION:

By: Craig B Foltz Date: 9/21/09

Printed Name: Craig B. Foltz

Title: Acting Division Director
Division of Astronomical Sciences

FOR THE NATIONAL PARK SERVICE:

By: Patricia L. Newbacher Date: 9/28/09

Printed Name: PATRICIA L. NEWBACHER

Title: Deputy Regional Director

FOR THE ADVISORY COUNCIL ON HISTORIC PRESERVATION:

By: _____ Date: 11/13/09

Printed Name: Reid Nelson

Title: Acting Executive Director

FOR THE HAWAI'I STATE HISTORIC PRESERVATION OFFICER:

By: _____ Date: 10/6/09

Printed Name: Laura H. Thielen

Title: Chairperson, DLNR Hawai'i

INVITED SIGNATORY TO THIS PROGRAMMATIC AGREEMENT:

FOR THE ASSOCIATION OF UNIVERSITIES FOR RESEARCH IN ASTRONOMY:

By: _____ Date: 9/21/09

Printed Name: WILLIAM S. SMITH

Title: PRESIDENT

INVITED SIGNATORY TO THIS PROGRAMMATIC AGREEMENT:

FOR THE UNIVERSITY OF HAWAI'I (for the benefit of its Institute for Astronomy):

By: M.R.C. Greenwood Date: 10-9-09

Printed Name: M.R.C. Greenwood

Title: President

CONCURRING PARTIES TO THIS PROGRAMMATIC AGREEMENT:

By: Warren S. Shibuya Date: 20 September 2009

Printed Name: Warren S. Shibuya

Title: Volunteer Maui County, Planning Commissioner
Retired Space & Missile Systems Center

CONCURRING PARTIES TO THIS PROGRAMMATIC AGREEMENT:

By: H. Kanoeokalani Cheek Date: 10-10-09

Printed Name: H. Kanoeokalani Cheek

Title: President

Ms. H. Kanoeokalani Cheek, President

NA KU'AUHAU 'O KAHIWAKANEIKOPOLEI

P. O. Box 5411

Kane'ohe, HI 96744

Approved at the regular monthly meeting of Na Ku'auhau 'o Kahiwakaneikopolei held on Saturday, October 10, 2009 at the University of Hawaii Manoa Campus.

ACRONYM KEY

A-E

Advisory Council on Historic Preservation (ACHP)

Advanced Technology Solar Telescope (ATST)

Area of Potential Effects (APE)

Association of Universities for Research in Astronomy (AURA)

ATST Native Hawaiian Working Group (ATST NHWG)

Air Force Environmental Compliance Assessment and Management Program (ECAMP)

University of Hawai'i's Environmental Health and Safety Office (EHSO)

H-M

Haleakalā High Altitude Observatory (HO)

Haleakalā National Park (HALE)

Heating Ventilation and Air Conditioning (HVAC)

Kanaka Maoli (Native Hawaiians)

Kupuna (elder)

Kahu (clergyman)

Long Range Development Plan (LRDP)

N

Native Hawaiian Organizations (NHOs)

National Historic Preservation Act (NHPA)

National Park Service (NPS)

National Register of Historic Places (National Register or NRHP)

National Science Foundation (NSF)

National Solar Observatory (NSO)

O

Office of Hawaiian Affairs (OHA)

P

Programmatic Agreement (PA)

S

Hawai'i SHPO (SHPO)

Special Use Permit (SUP)

T

Traditional Cultural Property (TCP)

U

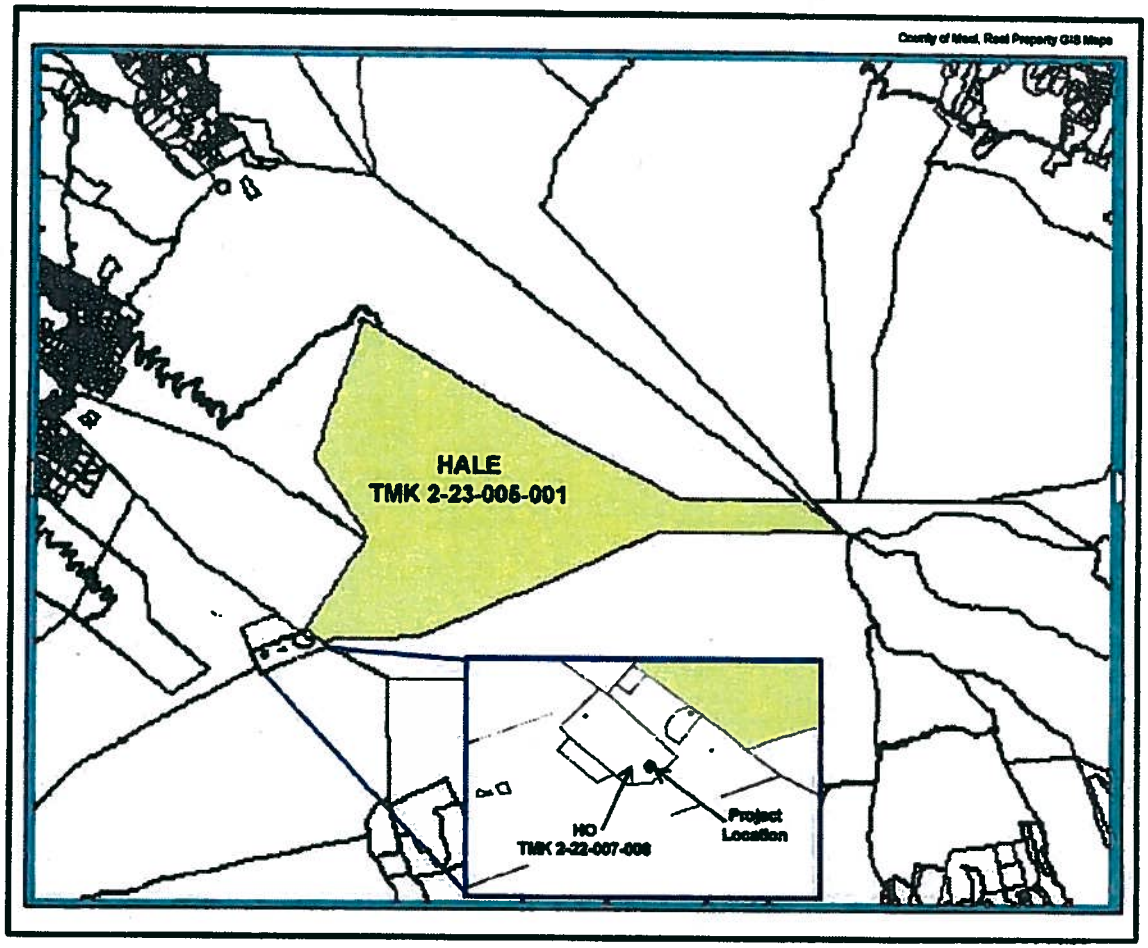
University of Hawai'i (for the benefit of its Institute of Astronomy) (UH IfA)

Exhibit A

Map of the Area of Potential Effects (APE)

and

Tax Map Key



TMK Maps: HALE and HO With Project Location

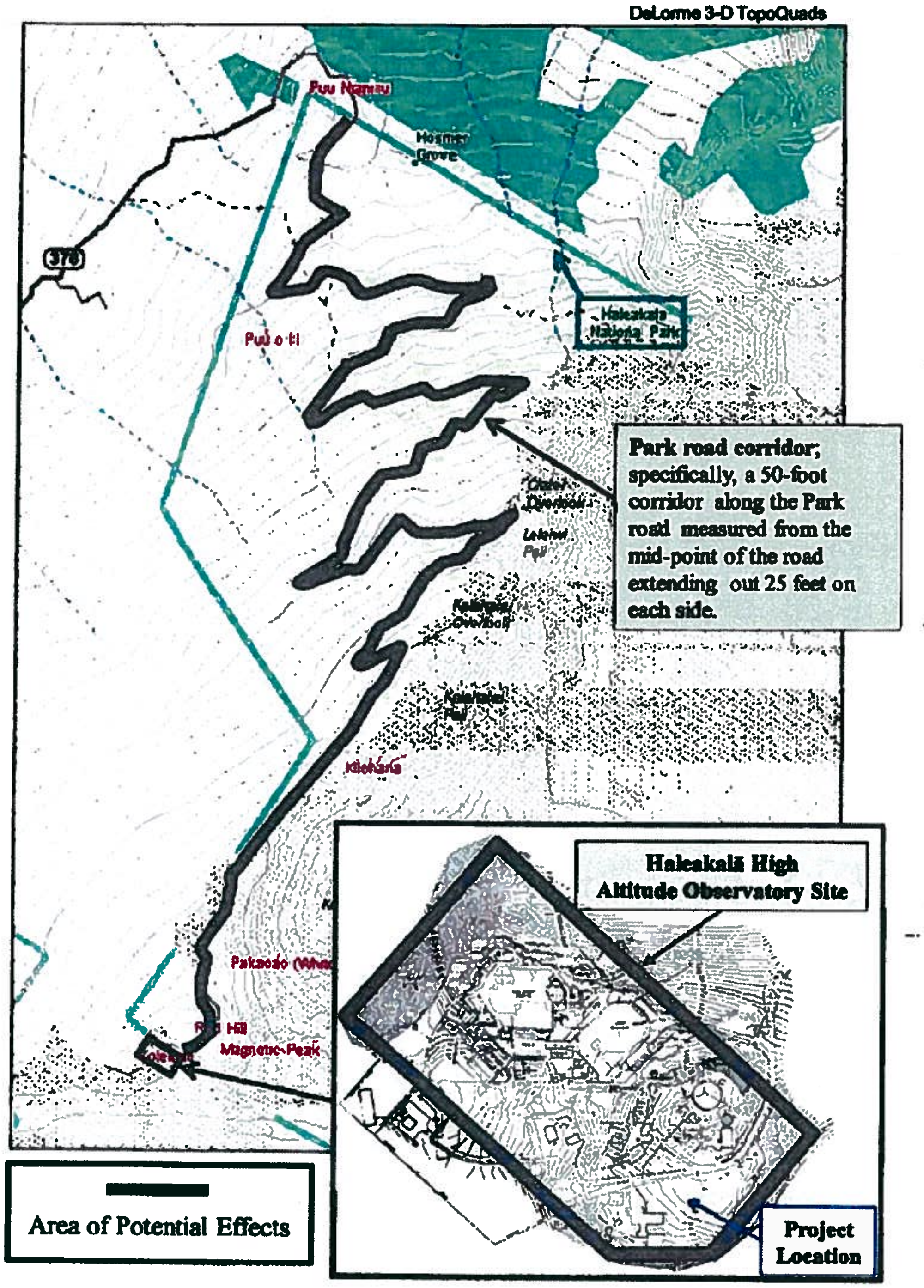

DeLorme 3-D TopoQuads
Hosmer Grove
Haleakala National Park
Park road corridor; specifically, a 50-foot corridor along the Park road measured from the mid-point of the road extending out 25 feet on each side.
Kilohana
Magnetic Peak
Haleakalā High Altitude Observatory Site
Project Location
Area of Potential Effects

Exhibit B

Best Management Practices
Excerpted from the
Long Range Development Plan for the
Haleakalā High Altitude
Observatory

[PREVIOUS TEXT OMITTED]

9.3.2 Protection of Historic and Cultural Resources

For the kanaka maoli, the lava, cinders, dust, rocks and boulders are all sacred to Pele, the goddess of the volcano. In fact, Pele means *lava* in Hawaiian. Workers at HO need to be culturally sensitive to the fact that they are in a place still considered sacred by Native Hawaiians. As the responsible agency, UH If A is committed to preserving the cultural resources at the site and has sought advice from the native Hawaiian community on Maui concerning the best methods to use to achieve that objective. One outcome of those consultations and the cultural resource evaluations of H 0 is that the If A has adopted rules for the long-tern preservation of archaeological and cultural resources for all facilities, past, present, and future, based on recommendations in the Cultural Resources Assessment (Appendix F). The preservation of cultural resources is defined as an If A policy as follows:

1. Any construction within HO requiring a permit from the Department of Land and Natural Resources shall require the consultation and monitoring of a Cultural Specialist. The Cultural Specialist will be engaged at the earliest stages of the planning process, monitor the construction process, and consult with and advise the on-site Project Manager with regard to any cultural or spiritual correction. For the purposes of this section, a Cultural Specialist must be a kanaka maoli, preferably a kupuna (elder), and a kahu (clergyman) as well, and one who has personal knowledge of the spiritual and cultural significance and protocol of Haleakala.

2. All cultural and archaeological sites and features identified in the HO Archaeological Inventory Survey shall be protected and preserved per Hawai'i Administrative Rules, Title 13, Sub-Title 13, Chapter 277 "Rules Governing Requirements for Archaeological Site Preservation Development". Protection shall include the establishment of clearly marked buffer zones and periodic monitoring by both the project Archaeologist and Cultural Specialist throughout any future construction process.

3. All construction crewmembers shall attend UH-approved "Sense of Place" training prior to working at projects within HO.

4. A Cultural Specialist shall conduct a cultural inspection of HO two times a year, to ascertain that HAR Title 13 Chapter 277 rules are being followed.

5. All permanent employees working at HO shall attend UH-approved "Sense of Place" training prior to working at facilities within HO.

The requirements specified above apply to and must be included in all land use-related Memoranda, Facility Use Agreements, Operating and Site Development Agreements and Leases.

Additionally, an area consisting of approximately 24,000 square feet and located

Southwest of the Maui Space Surveillance Complex, as further identified and more particularly described as Area A in Figure 9-1, will be set-aside in perpetuity for the sole reverent use of the kanaka maoli for religious and cultural purposes, on a noninterference basis with site activities.

Recommendations were submitted with the latest archaeological inventory survey concerning protection of the archaeological resources at the site, and they have been coordinated with the State Historic Preservation Division (Appendix H). These recommendations have been adopted by the If A to protect those resources. Passive in-place preservation will be continued for features that were identified and listed with State Historic Preservation Division during the J. C. Chatters 1994 survey, i.e., sites 4836,2806, and 2805 were delineated with post and railing boundaries in 1995. Discussions during the latest survey indicate that no fencing or other demarcation should be added to the most recently described features, so as not to draw attention to them. However, site 5440 will be part of the "set-aside" for kanaka maoli in Area-A described above, and the remaining four sites on HO property will be monitored routinely by the Cultural Specialist during inspections.

Exhibit C

List of Native Hawaiian Organizations that Are Consulting Parties

List of Native Hawaiian Organizations that Are Consulting Parties

Aha Ali'i O Kapu'aiwa O Kamehameha V
Ali'i Sir and Grand Master Clifford Hashimoto
P. O. Box 836
Hana, HI 96713

Central Maui Hawaiian Civic Club
Leone Purugganan
1126 Hoomalu Place
Wailuku, HI 96793

Historic Hawai'i Foundation
Kiersten Faulkner, AICP
Executive Director
680 Iwilei Road Suite 690
Honolulu, HI 96817

Kilakila O Haleakala
Ki'ope Raymond, President
310 W. Ka'ahumanu Avenue
Kahului, HI 96732

Maui Community College
Kaleikoa Ka'eo
310 W. Ka'ahumanu Ave.
Kahului, HI 96732

Maui Native Hawaiian Chamber of Commerce
Howard S. Kihune, President
P. O. Box 350
Kahului, HI 96732

Na Kupuna O Maui
Patty Nishiyama
320 Kaeo Place
Lahaina, HI 96761

Office of Hawaiian Affairs
Clyde Nāmu'o, Administrator
711 Kapiolani Boulevard, Suite 500
Honolulu, HI 96813

Office of Hawaiian Affairs
Jason Jeremiah, Policy Advocate, Preservation Native Rights, Land, and Culture
711 Kapiolani Boulevard, Suite 500
Honolulu, HI 96813

Office of Hawaiian Affairs
Thelma Shimaoka
Community Resource Coordinator
140 Ho'ohana Street, Suite 206
Kahului, HI 96732

Royal Order of Kamehameha I
Ali'i Sir William Garcia, Jr., CK
Office of the Ku' auhau Nui
P. O. Box 1072
Wailuku, HI 96793

Royal Order of Kamehameha I
Ali'i Sir George Kaho'ohanohano CK
2723 Kamelani Loop
Pukalani, HI 96768

Royal Order of Kamehameha I
Kahu Po'o Iki Clarence Solomon
P. O. Box 1072
Wailuku, HI 96793

Roselle Bailey
Ka Imi Na'auao '0 Hawai'i Nei
485 Lilihui Place
Wailuku, HI 96793

Lee Ann DeLima, Headmaster
Kamehameha Schools
275 A'apueo Parkway
Pukalani, HI 96768

Rose Marie Duey
Alu Like, Inc.
1977 Ka'ohu Street
Wailuku, HI 96793

Blossom Feiteira
Hui Kako'o 'Aina Ho'opulapula and Na Po'e Kokua
P. O. Box 2963
Wailuku, HI 96393

Kehaulani Filimoe'atu
Hui of Hawaiians
P. O. Box 492
Kahului, HI 96732

List of Native Hawaiian Organizations that Are Consulting Parties

Lei Ishikawa
Na Leo Pulama
P. O. Box 337
Wailuku, HI 96793

Kekealani Ishizaka
Hawaiian Homes Waiehu Kou 1
684 Kohomua Street
Wailuku, HI 96793

David Keala
Native Hawaiian Educational Council
240 Elilani Street
Pukalani, HI 96768

Velma Mariano
Paukukalo Hawaiian Homestead
Community
Association
644 Waihona Street
Wailuku, HI 96793

Dept. of Hawaiian Homelands
655 Kaumualii Street, Suite I
Wailuku, HI 96793

Iris Mountcastle
Queen Lilioukalani Children's Center
1791 Wili Pa Loop
Wailuku, HI 96793

Robin Newhouse
Keokea Hawaiian Homes
P. O. Box 748
Kula, HI 96790

Sheila Ople
A'o A'o O Na Loko I'a O Maui
140 Uwapo Road, #45-103
Kihei, HI 96753

Joann Ridao
Lokahi Pacific
1935 Main Street, Suite 204
Wailuku, HI 96793

Patrick Ryan
Fishpond Ohana
552 Kaiola Street
Kihei, HI 96753

Dancine Takahashi
Kamehameha Schools Alumni
P. O. Box 880069
Pukalani, HI 96788

Jim Wagele
Hawaiian Community Assets, Inc.
655 Kaumualii Street, Suite 3
Wailuku, HI 96793

Maui Community College – Ku'ina
Program
310 Ka' ahumanu Avenue
Kahului, HI 96732

Thomas T. Shirai, Jr.
Kawaihapai Ohana
P.O. Box 601
Waialua, HI 96791

Hui Kako'o 'Aina Ho'opulapula
767 Kailua Road, #212
Kailua, HI 96734

Hawai'i Maoli
P.O. Box 1135
Honolulu, HI 96807

Royal Hawaiian Academy of Traditional
Arts 835 Anuwale Street
Honolulu, HI 96821

Na Ku'auhau'o Kahiwakaneikopolei
P.O. Box 5411
Kane'ohe, HI 96744

Malu'ohai Residents Association
Ms. Shirley S. Swinney
P. O. Box 700991
Kapolei, HI 96707

List of Native Hawaiian Organizations that Are Consulting Parties

The Friends of 'Iolani Palace
Kippen de lba Chu
P. O. Box 2259
Honolulu, HI 96804

Hawaiian Civic Club of Hila
Mr. Arthur Hoke
P. O. Box 543
Hila, HI 96721

Papa Ola Lokahi
894 Queen Street
Honolulu, HI 96813

Kanu a ke 'Aina Learning 'Ohana
Ms. Taffi Wise
P.O. Box 6511
Kamuela, HI 96743

The I Mua Group
422 Iliaina Street
Kailua, HI 96734

Council for Native Hawaiian
Advancement 1050 Queen Street
Suite 200
Honolulu, HI 96814

Akoni Akana
Executive Director, Friends of Moku'ula
505 Front Street, #234
Lahaina, HI 96761

Mei-Ling Chang
Hui No Ke Ola Pono
P. O. Box 894
Wailuku, HI 96793

Kili Namauu
Punana Leo O Maui
P. O. Box 377
Wailuku, HI 96793

Clifford Libed
Dept. of Hawaiian Homelands Grants
Review Advisory Committee
P. O. Box 885
Wailuku. HI 96793

Haleakala National Park Kupuna Groups:

Kipahulu Kupuna Group
Alexander & Angie Aina
Shelia Agnitsch
Clifford Hashimoto
Henry Sr. & Annie Kahula-Rahl
Roland Kanuha
Ed Lincoln
Daisy Lind
Tweetie Lind
Sharon Mynar
Lyons Naone
Ida & Raymond Oliveria
Valerie Park
Terry Poaipuni
Eddie Pu
Caroline Smith
Nani Smith
Angela Tavares

Summit Kupuna Group
Charlie Aki
Gordean Bailey
Robert Garcia
Dana Hall
Clifford Hashimoto
Kaleikoa Ka'eo
Sam Ka'ai
George Kaho'ohanohano
Geraldine Kaiwi
Les Kuloloio
Florence Lani
Charlie Lindsey
Charles Maxwell, Sr.
Lyons Naone
Francis Poouahi
Leone Pugrugganan
William Roback
Leiohu Ryder
Maano Smith
Kalei Tsuha
John Belles
Ki'ope Raymond
Makaala Yates